THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXVI. No. 1950.] LONDON, SEPTEMBER 25, 1900. [52ND YEAR. PRICE 6d.

TROTTER, HAINES, & CORBETT,
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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
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Yield of Gas per Ton . . 10,500 Cubic Feet.
Illuminating Power . . . 16·4 Candles.
Coke . . . . . 68 per Cent.

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THE ORIGINAL
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Sent out in Dry Powder with Oils for mixing separate.
Is the most Durable Paint for all
EXPOSED IRON AND WOOD WORK.

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A PAINT MIXED READY FOR USE,
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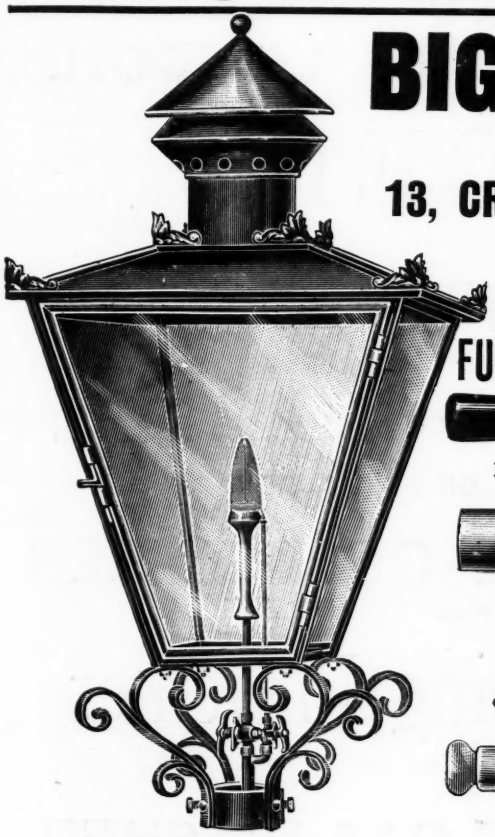
BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: LAMBETH BRASS & IRON CO., Ltd., Short St., LAMBETH.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GAS AND WATER ENGINEERS,
13, CROSS STREET, FINSBURY PAVEMENT,
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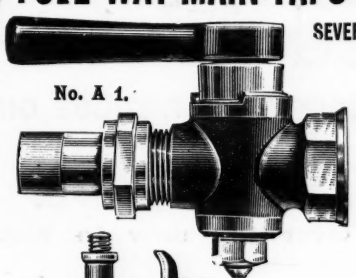
FULL-WAY MAIN TAPS & LANTERN TAPS.
SEVERAL DESIGNS SHOWN BELOW.

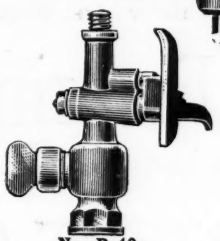
No. A.

THESE TAPS ARE
FULL-WAY
AS SHOWN.

No. A 1.


SUPERIOR QUALITY AND FINISH IN GUN METAL.

LANTERN TAPS.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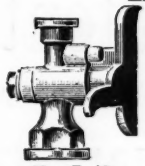
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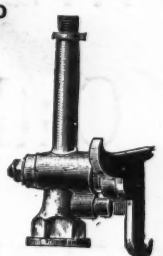
No. A 12.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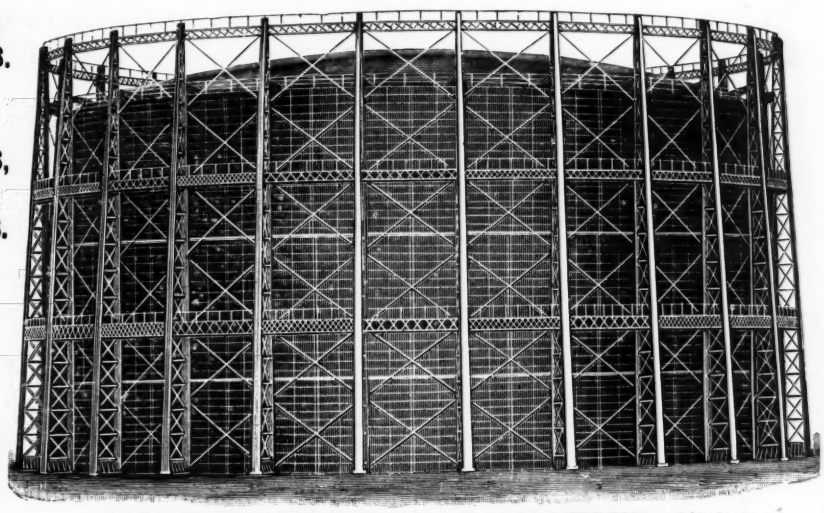

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Manufacturers of

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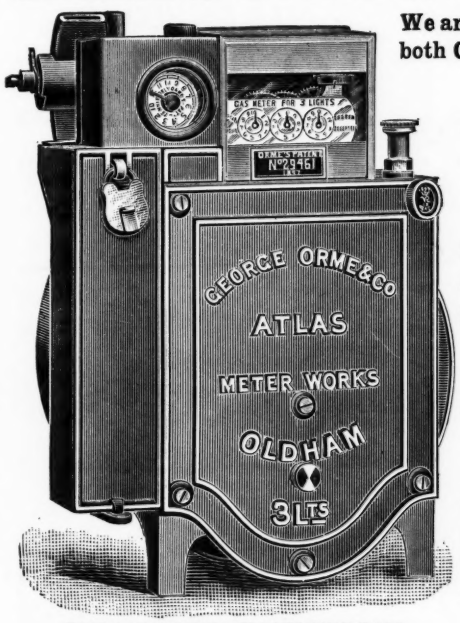


WET COIN METER IN CAST-IRON CASE.

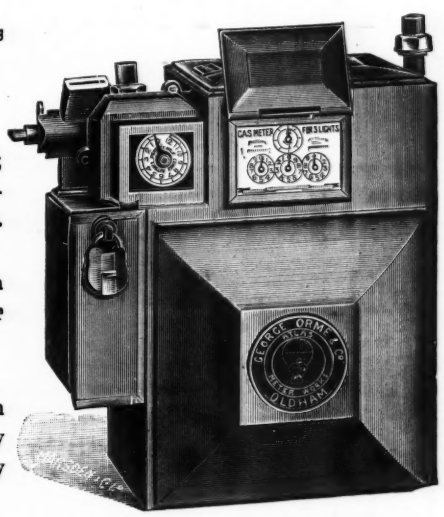
We are now supplying our Wet Coin Meters in Cast-Iron and Tin-Plate Cases, both Ordinary and Compensating; also Dry Coin Meters in Tin-Plate Cases.

A large number of these Meters are in use, and giving satisfaction.

The Mechanism is very simple; and there are no springs or complicated parts to get out of order.

We supply them to work with **1d., 1s., or any other Coin desired.**

The Selling Price of Gas can be changed *in Situ*, and any number of feet delivered, as may be required.



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RETORTS and FITTINGS, MOUTHPIECES with Self-Sealing Lids.

Improved COAL and COKE HANDLING PLANT, CONVEYORS, and ELEVATORS,

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PIG IRON (Special Quality) for Engine Cylinders. GAS COAL famous for its UNRIVALLED EXCELLENCE.

LOCOMOTIVES

LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c Locomotives of various Sizes always in Stock, ready for Immediate Delivery.

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VERY FREE FROM IMPURITIES.

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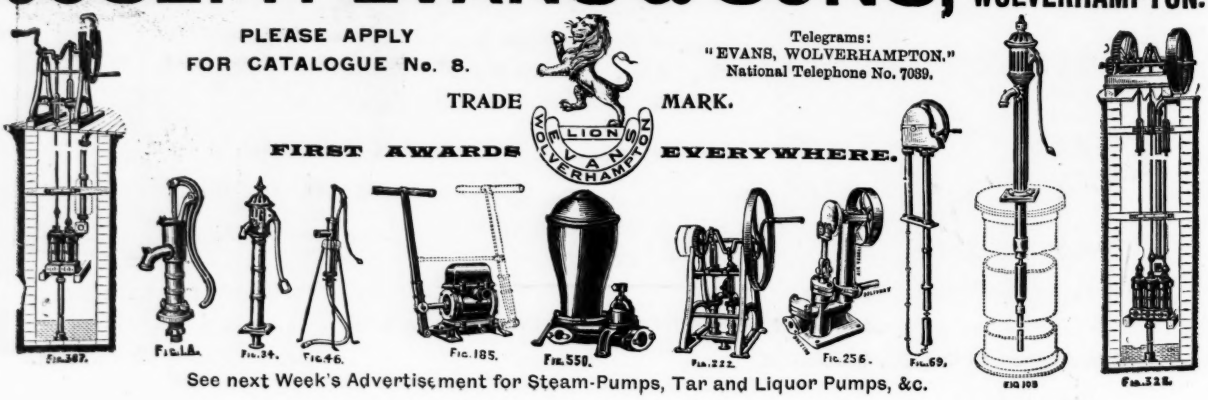

See next Week's Advertisement for Steam-Pumps, Tar and Liquor Pumps, &c.

THE DENAYROUZE LIGHT SYNDICATE, LTD.

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The Pioneers of Incandescent Burners without Chimneys.

THE "SMALL TORCH" Burner (Bandsept Patent) for Street Lighting, consuming **3½** feet of Gas per Hour, having an efficiency of **25-Candle Power per Cubic Foot of Gas** consumed at ordinary pressure, is not only the **BEST** but **CHEAPEST** intensive **CHIMNEYLESS** Burner on the Market.

PRICE COMPLETE WITH MANTLE

4s. 9d.

All other Burners supplied by the Syndicate proportionately reduced, full Particulars of which will shortly be issued to the Trade, and followed by new and complete Catalogue.

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COAL AND COKE BREAKING, ELEVATING, AND CONVEYING MACHINERY.
ROOFS.
BENCH, FURNACE, AND FLOOR IRONWORK.

MOUTHPIECES, WITH SELF-SEALING OR LUTED LIDS.

RETORT-SETTINGS OF EVERY DESCRIPTION.

INCLINED & HORIZONTAL, REGENERATOR, GENERATOR, & DIRECT FIRED.

SHALLOW REGENERATORS A SPECIALITY.

SOLE MAKERS OF HUDSON & RANN'S PATENT AUTOMATIC CHIMNEY DRAUGHT REGULATOR.

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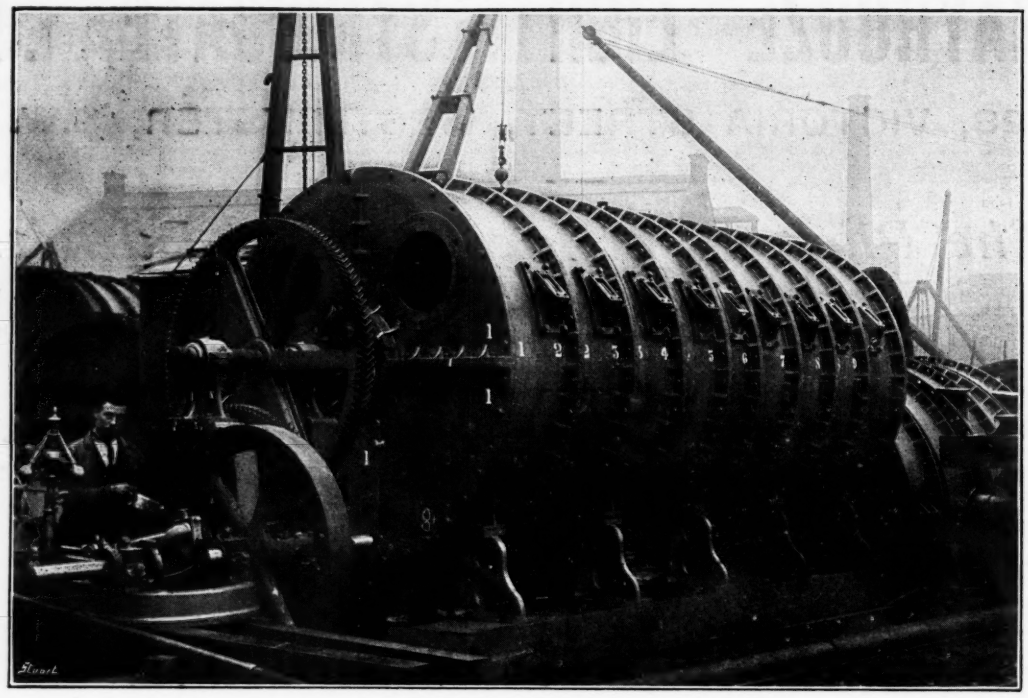
PATENT "NEW" SCRUBBER-WASHER

All Sizes from 50,000 to 5,000,000 Cubic Feet of Gas per Day.



The "NEW" Scrubber-Washer can be arranged to suit all cases of the Washing of Gases with Liquids.

NOTE:—Orders already received in **1900** for **MACHINES** to deal with **39,050,000** Cubic Feet of Gas per Diem.

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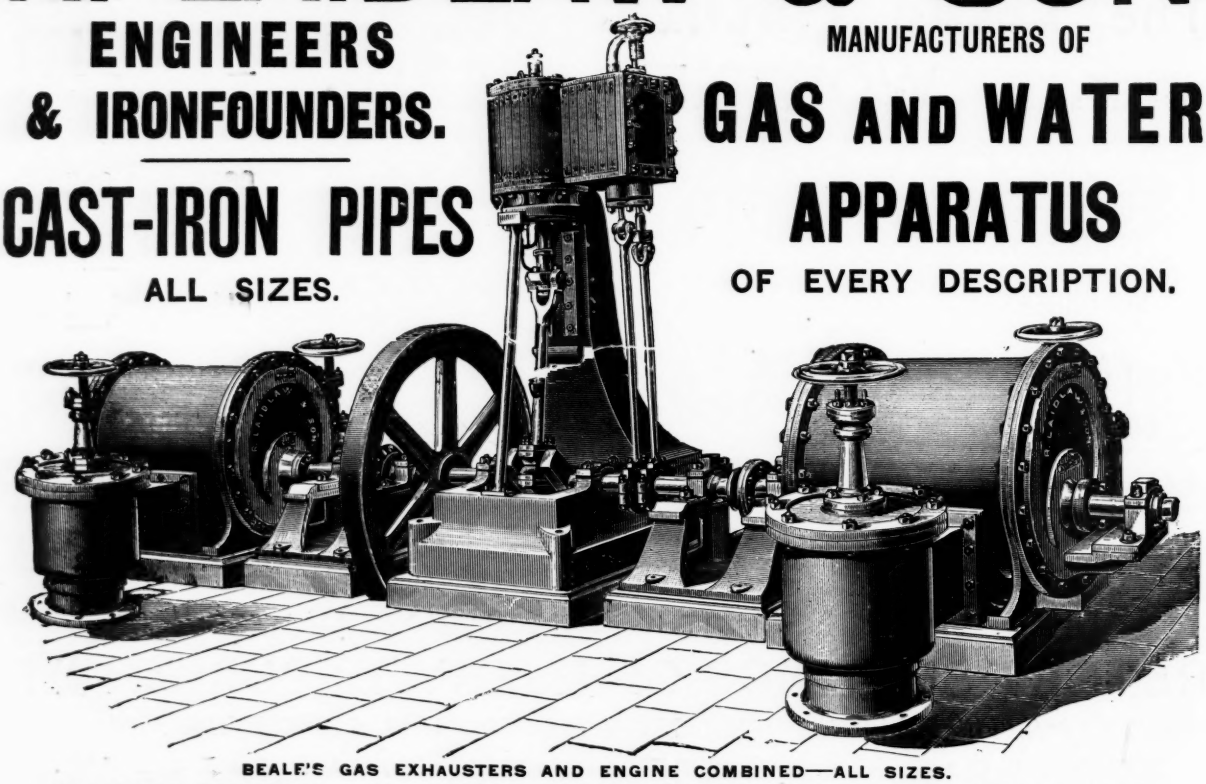
CAST-IRON PIPES

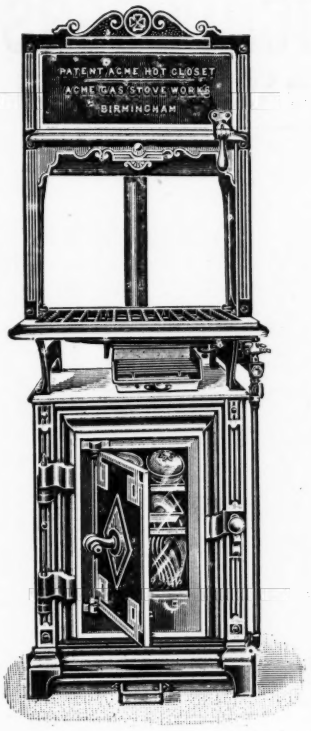
ALL SIZES.



BEALE'S GAS EXHAUSTERS AND ENGINE COMBINED—ALL SIZES.

ALLIANCE FOUNDRY, **GLASGOW.** | SIMON SQUARE WORKS, **EDINBURGH.** | 6, LITTLE BUSH LANE, **LONDON, E.C.**

THE LATEST AND MOST SUCCESSFUL DEVELOPMENT IN GAS-STOVES.



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Fitted with the Patent

HOT CLOSET & GLASS DOOR,

Has been a long-felt want in all Households, and costs nothing extra to Heat as all the Waste Heat from the Oven is utilized.

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Patent REGENERATIVE SETTINGS,

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SUITABLE FOR WORKS OF EVERY CAPACITY,

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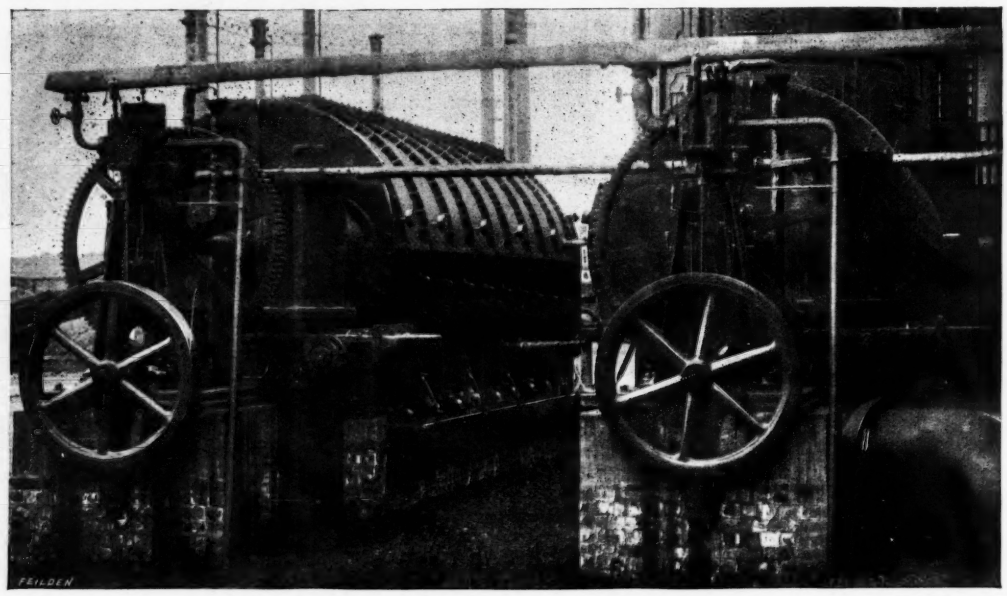
Cubic Feet of Gas per day are now being Purified by

PATENT "STANDARD" WASHER-SCRUBBERS

which extract ALL the Ammonia and a large proportion of the CO_2 and H_2S.

Prevention of Slip of Gas Unwashed
Strength of Liquor Concentrated.



Maximum Washing Surface.
Easy access to interior.

PHOTO. OF MACHINES RECENTLY ERECTED AT THE SCULCOATES WORKS, HULL.

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LONDON. —— LEEDS. —— GLASGOW.

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Telegrams:
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UNDER CONSTRUCTION BY OUR OWN WORKMEN.

Telephone
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RESERVOIRS, TRIAL BOREHOLES and WELLS. MAIN and SERVICE LAYING.

COMPLETE GAS and WATER WORKS ERECTED and SET to WORK including ALL MAINS.

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For Carbonizing Advt., see last Issue.

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CARBURETTED WATER-GAS PLANT

These instances are all from the LONDON designs of Messrs. HUMPHREYS & GLASGOW.

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Copenhagen (2nd)	2,500,000	Coventry (2nd)	600,000	Commercial Gas Co.	850,000
Belfast	1,700,000	Bordentown, N.J.	125,000	Commercial (2nd)	850,000
Belfast (2nd)	4,500,000	Winchester	225,000	Commercial (3rd)	1,250,000
Brussels	750,000	Shanghai	225,000	Rotterdam	850,000
Brussels (2nd)	750,000	Stockport	600,000	Dorking	150,000
Liverpool	3,500,000	Norwich	1,000,000	McKeesport, Pa.	500,000
Liverpool (2nd)	4,500,000	Holyoke, Mass.	600,000	G.L.&C.Co., Bromley	3,750,000
Tottenham	750,000	St. Joseph, Mo.	750,000	G.L.&C.Co., Nine Elms.	2,750,000
Tottenham (2nd)	750,000	Lea Bridge	350,000	Durham	200,000
Santiago de Cuba	400,000	Lea Bridge (2nd)	350,000	New York	4,000,000
Swansea	750,000	Stockton-on-Tees	500,000	Scarborough	800,000
Manchester	3,500,000	Edinburgh	2,000,000	Perth, W.A.	125,000
Brighton	1,750,000	Guildford	350,000	Bremen	550,000
Preston	1,400,000	Brentford	1,200,000	Maidenhead	225,000
New York	1,200,000	Syracuse, N.Y.	850,000	Epsom	225,000
Southport	750,000	Bridlington	150,000	North Middlesex.	150,000
Bath	1,000,000	Middlesbrough	1,250,000	Wandsworth	1,800,000
Newburg, N.Y.	350,000	Croydon	1,250,000	Aarhus	800,000
Newburg (2nd)	250,000	L. & N.W. Ry., Crewe	700,000	Falmouth	150,000
Hoylake	125,000	Taunton	225,000	Southampton	800,000

SINCE JANUARY 1ST, 1899.

Hartlepool	750,000	Brighton (2nd)	1,850,000	Dublin (2nd)	2,000,000
Utrecht	1,000,000	Stockport (2nd)	600,000	Faversham	200,000
Deventer	150,000	Croydon (2nd)	625,000	Birmingham (Swan V'ge)	1,500,000
Portsmouth	1,000,000	Maidenhead (2nd)	225,000	St. Gallen (Switz.)	225,000
Bournemouth	1,000,000	G.L.&C.Co., Beckton	2,250,000	Colney Hatch	400,000
Aylesbury	150,000	G.L.&C.Co., Fulham	1,750,000	Southampton (2nd)	500,000
Hamburg	1,750,000	Tottenham (3rd)	350,000	Tunbridge Wells	1,000,000
Redhill	275,000	Sydney (Harbour)	500,000	Hebden Bridge	200,000
Dublin	2,000,000	Sydney (Mortlake)	500,000	Chorley	300,000
Posen	450,000	Manchester (2nd)	3,500,000	Liège	1,000,000
Dunedin (N.Z.)	150,000	Hull	1,500,000	Stafford	500,000
Lincoln	500,000	Longton	600,000	Bridlington (2nd)	200,000
Antwerp	1,500,000	Staines	600,000	G.L.&C.C., Beckton (2nd)	10,750,000
Brussels	1,000,000	Commercial (4th)	2,000,000	Tottenham (4th)	1,000,000

[The 1891 Installations of The Gaslight and Coke Co., 12,000,000 Cubic Feet Daily.]

Total Capacity above 128,750,000 Cubic Feet Daily.

United States Total 246,550,000 Cubic Feet Daily.

Grand Total - 375,300,000 Cubic Feet Daily.

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UNITED STATES OFFICE:
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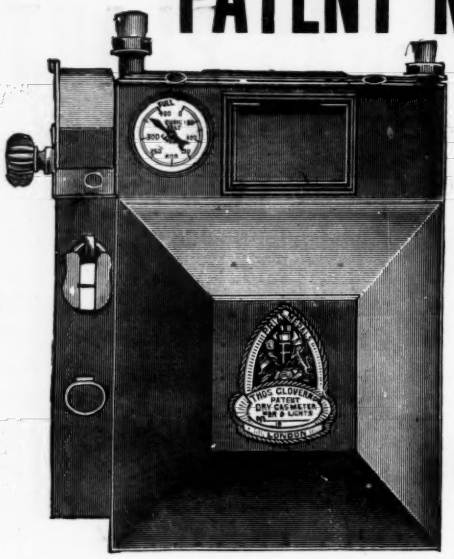
THOMAS GLOVER & CO.'S PATENT NEW IMPROVED PREPAYMENT METER



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Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

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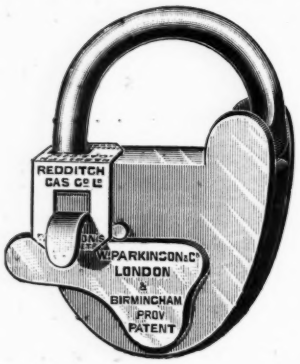
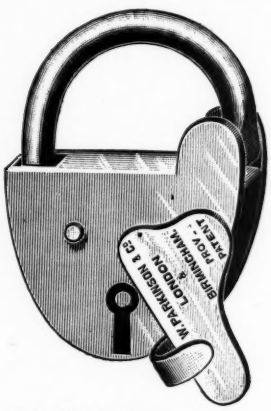
28, BATH STREET.	1, OOZELLS STREET.	37, BLACKFRIARS STREET.	69-71 McALPINE STREET.
Telegraphic Address: "GOTHIC."	*Telegraphic Address:* "GOTHIC."	*Telegraphic Address:* "GOTHIC."	*Telegraphic Address:* "GASMAIN."
Telephone No. 1605.		Telephone No. 8398.	Telephone No. 6107.

W. PARKINSON & CO.

PATENT PREPAYMENT METER SEAL LOCK





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EDITORIAL NOTES.

The Dissolution.

THE dissolution of Parliament has come, as most people expected, with the conclusion of the war in South Africa and the consequent necessity for making it clear to the world what the English nation wishes the Government to do next. That is the short point, as the lawyers would say, of the pending appeal to the British electorate. We can say nothing here, of course, on the main question actually before the country; but it is worthy of remark how completely all sectional issues and small side causes are "out of it" this time. The fiery cautery of War has burnt out most of those "cankers of a calm world and a long peace," which spot the body politic at other times. There is less chance than ever of mere faddists getting into Parliament by election eddies in out-of-the-way constituencies. If only the constituencies will return honest gentlemen to represent them, and will send about their business the bores and faction-mongers, the country will do well. After all their bluster and pretence of representing "the workers" of the nation, the combined strength of the political Trades Unionists, the Social Democratic Federation, and the Independent Labour Party appears to be scarcely equal to the task of putting three serious candidates in the field. The election addresses of the members of the present Government naturally do not contain any programme of domestic legislation for the new Parliament; and those of the Opposition leaders are almost as reticent. Vague references are made, in some of these declarations, to the need for further industrial legislation and other every-day matters; but nobody pretends that these are of any real political importance at this juncture. With that remarkable knack for getting themselves disliked by their fellow-citizens which distinguishes our Socialists and Independent Labour people, the election managers of these eccentrics have insisted on identifying them with the anti-war fanatics—as if there were not sufficient obstacles already to their getting into Parliament! The British Workman is not very likely to vote for those who forget or belittle his share in doing his country's work in South Africa. The old Parliament was a very good one, on the whole. It had its irrepressibles, of course—men who were for ever speaking and wasting public time; but it also contained a very large proportion of the best blood and intellect of the nation. We cannot send to Westminster better men than the country breeds; but so long as Englishmen of the right sort continue to offer themselves for election to Parliament, and constituencies return them, this realm will take no hurt from foes or factions.

The Meeting of Eastern Counties Gas Managers—Coal Prices, Workmen's Compensation, and other Topics.

THE quaint old Lincolnshire town of Spalding—the home of the President, Mr. J. G. Hawkins—was visited by the Eastern Counties Gas Managers' Association last Wednesday; and a very profitable day was spent. Although a man of few words at public meetings, Mr. Hawkins has a record which marks him as a thorough gas practitioner. His works, wherever he has been in charge, have spoken for him. The visit to the Spalding ones on Wednesday was an object-lesson for many of the managers who were fortunate enough to be able to attend. There they saw proof that even works on a moderate scale are not debarred from participation in the benefits of advanced engineering. The works have been practically reconstructed during the management of Mr. Hawkins; but nowhere can one trace that a penny of capital has been misspent. Everything has been done to produce gas on the most economical and modern lines; and in fact the works might, with advantage, be taken as an exemplar by many more extensive establishments. Mr. Hawkins's ingenuity has been brought to bear upon the retort-house work; and for a modest outlay he has produced at home appliances of unpretentious appearance which appear as successful in alleviating the toil of the stokers and expediting the performance of their duties as perhaps more expensive apparatus would be in a house of such limited dimensions. We expect to hear of other managers taking a leaf out of Mr. Hawkins's book; and they will not regret it.

No complaint can be made of the quality of the matter provided for the meeting. While it does not give much scope for comment, it was of a useful character. Never given to verboseness, the President restricted his address

to quite an unobtrusive length. Yet, its brevity notwithstanding, he stated his views, with refreshing directness, on quite a multitude of current subjects. The address, of course, contained (and it would not have been complete without) a reference to *the* topic of the day—the price of coal. With some of the luminaries in the gas profession who have made pronouncements on the question, Mr. Hawkins thinks that the existing high price cannot last much longer; and he founds his belief on the fact that "stocks are increasing everywhere, and buyers are being "flooded out with coal." So far we go with the President; but we cannot follow his reasoning when he proceeds to say: "Had all of us held off a short time "ago from making contracts, and bought lightly as "required, prices to-day would very likely have been "lower than they are." To our mind, the probabilities are that they would not have been. Looking critically all round the question, we cannot see how the direct opposite of what the President first of all advanced would have had a similar and perhaps quicker effect. This does not appear to us to be a case in which a temporary excess of supply over demand would have had such a beneficial result. The coalowners, if unwise, are not dolts, and they are as capable of judging within a little what the requirements of gas undertakings will be as are those who have the direction of such concerns. Therefore, is it not likely that, when they found gas companies were only buying from hand to mouth—knowing that they could not carry on their business without coal, and that, consequently, the demand would be from sheer necessity a continuous one—they would simply have smilingly sat still, and booked the orders as they flowed in at the still high prices? The greatest sufferers would eventually have been the gas companies themselves, who, when their needs were greatest in the winter, would have found themselves barren of stocks, deliveries erratic, the gas supply in jeopardy, and the coal-owners coolly and suavely demanding their own prices. The condition of the gas manufacturer would, without doubt, have been immeasurably worse this winter than last. What has happened, and what is happening, are, so far as can be judged, the best remedies for restoring the coal market to, at any rate, something approaching a healthy state. At the same time we grant that those who have not been compelled to contract yet may have "the best of the deal." One other point in the President's address is particularly noteworthy. The commotion caused by the Workmen's Compensation Act has long since died away; and it has not proved the haunting phantom that it was expected it would be. The Act, Mr. Hawkins tells us, has proved a friend in disguise at Spalding; for the amount paid to the insurance company is less than was formerly required to meet cases of injury to workmen.

Inclined retorts have not so far obtained a strong footing in the Eastern Counties—in fact, we believe Cambridge is the only town represented in the Association which has an installation. It was therefore not surprising that the paper read by the member for Cambridge—Mr. R. Brown—did not draw a very brilliant discussion. The only real critic was Mr. R. G. Shadbolt; and the other speakers merely joined in for the purpose of eliciting information. The paper itself, taken in conjunction with Mr. Brown's reply, will command attention for the exact figures furnished as to the working of the installation. In Mr. Brown's experience, the great secret of success in working inclines is to have a properly constructed furnace. Further, using screened nuts, he is not worried by the "creeping" of the charges; and the production of gas, compared with ordinary coal, is not affected. The question of the creeping of coal is an anxious point with our Copenhagen friend, Mr. F. D. Marshall; and doubtless he will be glad to hear of Mr. Brown's experience. Among other matters which occupied attention at the meeting, Mr. C. W. Phillips gave some fresh information regarding the Scott-Snell-Phillips self-intensifying lamp; two new members were elected; and Norwich was selected for the Spring meeting.

The Gas Affairs of New York.

In January last we gave an account in these columns of the latest "Gas-Rate War" of New York. The particulars will be found in the "Journal" for Jan. 2. It was a case of fighting to a finish for the gas business of the city, between the men in possession (the Consolidated Gas Company) and outside capitalists. The conflict dragged on for some months; but quite lately it has ended in the complete triumph of the Consolidated Company. The others were beaten to the ground; and the Consolidated bought them up at a discount. Now there is again only one Gas Company in New York, although the once-competing undertakings still retain their own names and affect an independence which is not theirs in reality. So far as the public is concerned, the immediate consequence of the termination of the war of prices is the return of all the Companies to the uniform statutory rate of $1·05 per 1000 cubic feet, and a uniform charge of $3 a year for a gas-kitchener. Advertisements to this effect in the New York papers were the only public notification that the gas magnates had ceased to dispute with one another for the bodies of the Metropolitan consumers. But this is not all. It begins to look as though the gas administration had definitely turned over a fresh leaf. Not only are the *pseudo*-Companies actively advertising and pushing gas-stoves, they are putting their affairs in better trim than has ever been possible under the old circumstances. The badly-situated in-town stations are to be done away with and cleared off; splendid new works being planned in a better situation. It is stated that there will be no more competition; the Consolidated interests being now supreme, not only over the gas supply, but also over the electric lighting. This security from future piracy is stated to ensue from an Act of the State Legislature which forbids the granting by the local authority of any new "franchise" for the opening of streets without the consent of a majority of the frontagers. This will be practically impossible to obtain; public opinion being strongly averse to further aldermanic trafficking in franchises, which has long been so fertile a source of municipal corruption.

It is also believed that American business men begin to realize that competition among identical public services is an economic fallacy. The substitute they seem to favour for the time being is a legislative assize of prices. Thus the price of gas in New York is for the current year $1·05; next year it will be the even dollar per 1000 cubic feet, which satisfies public opinion. The State Legislature, in fixing these prices, does not act blindly. All treasurers of joint-stock undertakings in the State of New York are bound by law to make a sworn disclosure yearly of the state of a company's affairs, as fully and correctly as they know them. These particulars are not published to the world; but those who have a right to know the truth can always get at it. The limitation of the dividends paid by trading companies, including gas companies, is not an article of American commercial faith; and Americans do not believe that it does any real good in England. It is not a high rate of dividend, but over-capitalization, which is the curse of joint-stock enterprise in all countries. The American gas companies have doubtless been extravagantly capitalized in the past; but this is to a certain extent a national fault. Financial America claims to be settling down to serious business, after sowing its wild oats; and the Consolidated Gas Company of New York are going to be one of the strictest of plaindealers henceforward.

The Coal Market.

As we noted a week or two since, the coalowners of the country are beginning to realize, somewhat too late in the day, the fact that their action in taking full advantage of the temporary failure of the supply of coal to equal the demand, and running the price up to the extreme height possible, is having and will have a disastrous effect upon the trade of the country. They had this consideration brought to their notice last week by the Lord Mayor of Bristol, Sir Herbert Ashman, who officially welcomed to the city the members of the Institution of Mining Engineers, assembled there to hold their annual general meeting. Sir Herbert said that he did not know whether, as Lord Mayor, he might presume to caution those whom he welcomed; but sometimes one had to accept responsibilities, and he could not help saying that there was at the moment a danger of coal becoming too dear. There was a risk of proprietors grasping at the immediate advantage, and, as it were, "killing the goose which laid the golden eggs," by forcing prices to a point at which manufacturing energy might be paralyzed. "The result of such a course must, of course, "be ultimate disaster." Sir Christopher Furness, speaking about the same time at the first annual meeting of the Weardale Coal, Coke, and Steel Company, expressed himself to a similar effect. He said that personally he was a little alarmed at the high price of coal in this country. It suited them as colliery proprietors to receive good prices

and pay high dividends; but he looked at the matter from a larger point of view—as one of a nation which only existed by the increase and development of manufacturing industries, and he would not be sorry to see a reduction in price take place very soon. We do not wish to be ungracious, but that remark savours rather strongly of making a virtue of necessity. The price of coal will, there is some reason to hope, go down soon, whether the colliery proprietors be glad or sorry; so apparently both parties will be thereby satisfied.

It is, indeed, amusing to note that the President of the Institution of Mining Engineers, Mr. H. C. Peake, when acknowledging the remarks of the Lord Mayor to which we have referred, was good enough to say that, "as regarded the "price of coal, he agreed with his Lordship that this should "not be allowed to go much higher." It is always wise to affect, like the fox in the fable, not to desire that which is beyond one's reach, and Mr. Peake is most considerate of the consumer—now. But if, by the occurrence of some unforeseen event—say, the advent of severe winter in mid-October—the demand for coal were suddenly increased, we wonder if Mr. Peake or the coalowners would be found saying that the price of coal "should not be allowed to go "much higher?" To Mr. Peake's further remarks, giving his explanation of the present situation, there is no exception to be taken. He pointed out that during the lean years, when coal mining could only barely pay its way, without the owners dealing very satisfactorily with the demands of the "depreciation" account, there was no inducement to colliery proprietors or to the public to invest more capital in sinking new shafts, and thereby increasing an output already adequate or more than adequate to meeting the demand. The result was that when the sudden increase in trade activity came about, the consequent heavier demand for coal could not be immediately met. Moreover, cheap coal means wasted coal and unnecessarily heavy purchases. *Hinc illæ lachrymæ.*

This being undoubtedly the case, it is satisfactory to note that in every direction steps are being taken to increase the output, by the sinking of new shafts and the re-working of disused mines; while purchasers are doing everything possible to reduce the demand. Indeed, were it not for the continued heavy shipping orders received from the Continent—both in France and Germany coal appears to be scarcer than ever—we should say the prospects for the near future were brighter at present than they have been for some time past. Unfortunately, the trouble with the miners in America (about one-fourth of all the coal miners employed in the States are said to be on strike, and prices are bounding up), will for the time being tend to delay the progress of the delivery of American coal in Europe. It is worth noting that our own Admiralty have recently bought coal from "the other side;" that during the first seven months of this year about 77,400 tons of coal have been imported into France from the United States; and that a Swiss-Italian Company has been formed at Genoa, with a capital of some £800,000, for the purpose of buying and distributing American coal. We have, therefore, a direct interest in the state of the American coal market.

We deal elsewhere with the outlook in the iron and steel trades, which, so far as it is possible to judge, is decidedly favourable to the expectation of cheaper coal in the near future. Indeed, information that has come to hand since that article was in type only goes to confirm its conclusions. The past week is, in fact, reported to have been, in spite of lower prices and a decided break in the Glasgow pig-iron market, one of the quietest of the whole year in regard to the new orders received. The journal of the allied industries—the "Iron and Coal Trades Review"—states that the feeling is that there will shortly be a considerable reduction, not only in the price of coal, but in iron, ore, and other raw material. The stoppage of work in the Lancashire mills, and the continuation of fine, open weather, both make for an easing of the market.

The Report of the Joint Committee on Municipal Trading.

THE careful attention of members of local authorities, gas companies, and indeed of everybody interested in the practical politics of local self-government in the United Kingdom, may well be directed to the contents of the report of the Joint Committee of Parliament on Municipal Trading, just issued as a Blue-Book. The report of the Committee is purely formal; merely stating that it was not possible to bring the inquiry to a satisfactory conclusion during the session, and recommending its continuance. They have therefore published the minutes of evidence as taken, with an appendix; and this collection of statements, emanating mostly from persons of unquestioned competence, is now available for the instruction of the public in the matters germane to the general question. The result is a text-book which cannot be safely ignored by those who profess views for or against the principle of municipal trading. We do not propose to examine in detail the substance of this Blue-Book. To do so at adequate length would be an undertaking far beyond the compass of our columns. We must therefore rest content with commending the record itself to the earnest study of interested persons; with the observation that it contains matter that tends to support the judgment of those who have been inclined to think that, while the idea of municipalization is encouraged by a superficial survey of the question, a deeper inquiry points to a different conclusion. The present is notoriously an age of hasty generalizations from "tit-bits" of undigested information. The noisiest and most cock-sure of political and social reformers, on the Platform and in the Press, get hold of a few small facts and work them to death. These laborious inquiries supply the best antidote to this hand-to-mouth idea of the way to deal with political problems; and those who will take the trouble to follow them, will never lose their pains.

A Deceiving Meter.

AMID the dying echoes of war and the growing mutterings of a General Election, the London newspapers last week found a pleasant interlude in the communications that have passed between the South Metropolitan Gas Company and the Rotherhithe Vestry respecting certain arrears of the gas charges for the local Baths and Washhouses. It appears that for the past eighteen years the gas-meter of this establishment has been misread, with the result that the Vestry have been charged only one-tenth of the correct amount. This extraordinary blunder arose, it is stated, from the circumstance that the meter, which belongs to the Vestry, is peculiar in having the "thousands" dial where the "hundreds" dial is situated in ordinary meters. The meter inspectors took the registration as they were in the habit of doing, never suspecting, it appears, that they were entering thousands as hundreds of cubic feet, and so on. This is the remarkable part of the story. It seems odd the smallness of the gas consumption recorded for such an establishment was not discovered at once. The story goes that when the apparent fact was noticed, the meter was tested and found to register correctly. Yet, though the first dial on the face of the meter is plainly lettered "thousands," underneath it, the inspectors evidently never dreamed of regarding the legend as giving the key to the mystery. It is very easy to blame them for this blindness; but how should they ever expect one meter in the whole district to have dials set differently from all the rest? At last, a London County Council meter inspector was called in to test the meter; and he reported that the index showed a total consumption of 26,000,000 cubic feet since the meter had been working—it was new with the Baths—whereas the Company's books only showed a registration of 2,600,000 feet. Investigations followed; and as a result the Company have sent in a little supplementary account for close on £3000. When this bill and the explanation came before the Vestry, there was, naturally, an explosion. Some of the members were heard by the vigilant reporters to mutter "Don't they wish they may get it," or words to that effect. The incident is certainly curious, and we imagine unprecedented. There is no denying the fact of the Vestry having had the gas; and common honesty prescribes that it should be paid for. At the same time, some consideration is due to the present-day victims of the Company's long-continued mistake. The incident shows the possibilities that lie unsuspected in the term "unaccounted-for gas." We imagine that the law of the matter, as well as the justice of it, are on the side of the Company's claim. Meanwhile, the story has had quite a vogue in the newspapers.

Private Enterprise at Bristol.

IN occasional discussions of the problem of improving the dwellings of the industrial population of towns, we have consistently taken the view that the migration of industries to the outlying regions might prove a satisfactory partial solution of the difficulty, where rapid transit is available. It is gratifying, therefore, to learn, on the authority of the

last annual report of the Chief Inspector of Factories, that something like this adjustment is actually in progress in and near Bristol—the instigating influence being the electric tramway. It is stated that, in consequence of the boldness of the Tramway Company in running their fast and frequent services into suburban districts previously sparsely populated, several firms of manufacturers have already built fine and commodious modern factories in these regions, to replace their old pent-in establishments within the walls, and are further providing neat and good housing accommodation for their hands. This revolution in the industrial life of Bristol has been rendered possible solely by the circumstance that a neighbourhood penetrated by an electric tramway is never "out of the way." People can live, and carry on industries in such localities, while still having the conveniences of the city close at hand, so to speak. As our contemporary the "Hospital," in commenting on this intelligence, very wisely observes, it is nonsense to maintain that only the country can be healthy. Towns would be healthy enough if they were only opened out. The choice between the factory in the centre of the town, and that planted a few miles out, yet fully within call through the agency of swift transport facilities, is determined in favour of the latter by numerous considerations. To the proprietor, it is a matter of rent, rates and taxes, and room. To the workpeople, it is a question of light and air, of a regular home life, and relief from the worry of catching trains. If the workman must reside near his town employment, it means either living in a slum, or shut up in a gloomy block of buildings in a dark street. If this is not necessary, the alternative is workmen's trains. Far better move both factory and workpeople out in the open, where the men can get home to their dinners. Not the least satisfactory feature of this Bristol news is the spontaneity of the movement. Mr. Priestman, of Bradford, has just told the British Association meeting in that enterprising town that municipalization is the only remedy for all shortcomings of town equipment. This is a hard saying, and one that common experience does not bear out. It may be impossible in Bradford to get a pennyworth of good milk unless one goes to the Town Hall for it; but in Bristol, at any rate, private enterprise still seems to be good for even bigger things.

A Question of Style.

It has happened more than once for the "Journal" to pose as a stickler for the use of plain, good English in technical writings. Whatever scheme of technical education may be devised for the behoof of the young engineer of the future, and whatever examinations he may be required to pass, it is to be hoped that any sign of slip-shod tendency in his use of English will be visited with the sharpest condemnation. Technicians who enjoy the privilege of having English to speak and write in, must be made aware that they are individually responsible for maintaining the purity of the language. Technicalities, slang expressions even, do not degrade a language, as does the slovenly use of words and the foggy construction of sentences. It is, of course, possible to use slang quite accurately; whereas ordinary words employed in a wrong sense constitute really bad language. Take, for example, the following passage, drawn almost at random from a technical paper. The writer is discussing the quality of the oil used for lubricating air-compressing cylinders; and he remarks: "It cannot be "too volatile, or its flash-point and burning-point will be "dangerously low; and it cannot be too heavy, or it may "with the dust form a gummy mixture," and so on. Now the context shows plainly enough that the wretched man meant "must not" when he wrote "cannot." When one says in English that an oil "cannot be too light," the meaning sought to be conveyed is that it should be as light as it can possibly be obtained. Yet here the exact opposite was intended. The example is a very glaring one; but it serves to point the moral. Such a misapplication of words in a patent specification would imperil the validity of the patent.

Corrosion of Cast-Iron Mains.—The corrosion of a water-main at St. John's (New Brunswick), under unusual circumstances, is reported by Mr. W. Murdoch, Engineer of the water and sewerage works. It is a 24-inch cast-iron pipe; and the manner in which it has been injured is described by Mr. Murdoch as follows: "Some portions are quite soft, partaking more of the nature of graphite than iron; the metal being disintegrated by salts contained in the soil, which was flowed by the tide about a hundred years ago." Similar instances of corrosion have been reported from Boston and other places.

WATER AND SANITARY AFFAIRS.

The progress of the epidemic of bubonic plague with which Glasgow was visited about a month ago continues to be the most important topic in connection with sanitation. Unfortunately, two additional deaths occurred in the hospital last week, making six in all; but, on the other hand, a number of cases under observation have been dismissed from the reception-house—the period of incubation having been safely passed. The death-roll is not officially regarded as remarkable, considering that the disease had a long start in one of the poorest districts of the city. It is noteworthy that two fresh cases which occurred last Thursday were those of a woman and her daughter living at Tradeston—something like a mile distant from the locality where the outbreak originated. The inference must not be drawn, however, that the sanitary conditions of this particular district are such as to favour the propagation of plague, as there was direct evidence that the parties attacked had been in contact with previous cases. Had this not taken place, the chances are that they would have escaped. This points to the necessity for the prompt isolation of all suspected cases during the period of incubation. Unfortunately, the poorer classes, with whom isolation is out of the question, not unfrequently object to the removal of members of their families who may be suffering from infectious diseases; and it is only when medical men are armed with authority to insist upon this being done, that the patient is prevented from becoming a source of danger to others. As our readers are aware, ample arrangements have been made by the authorities in Glasgow for the reception of suspects; and although, as mentioned last week, the medical staff at Whitehall have not the slightest fear of an epidemic of plague in London, it has been deemed advisable to issue an order to Medical Officers of Health in England and Wales, and others specially concerned, to immediately notify to the sanitary authorities and to themselves all cases of plague, in the same manner as ordinary infectious diseases. It is to be hoped that none may arise; but while there is the possibility—we do not for a moment say probability—of their occurrence, the Local Government Board have taken the very proper step of ordering their notification.

In dealing with this matter in the "Journal" for the 4th inst., and again last week, we emphasized the importance of sanitation in staving off attacks of the disease which is now causing trouble in Glasgow, and suggested that attention should be turned to those places where conditions exist which might, under certain circumstances, favour an outbreak. Of these, notwithstanding the existence of the Parish and District Councils created by the Act of 1894, there are, as we remarked, probably not a few; and, curiously enough, the existence of one in Surrey, not many miles from Whitehall, was evidenced by a letter which appeared in "The Times" on Thursday last. Our contemporary had recently been commenting—and not very favourably either—on the work of the above-named bodies. It was pointed out that the farmers, who are generally in a majority on these Councils, have no very keen sympathy with schemes of sanitary improvement, which necessarily cost money, and involve an addition to the rates, which it is their main thought to keep as low as possible. Consequently, the promoters of a much-needed drainage or water supply scheme will possibly have to contend with "the opposition of their own representatives, "and certainly with reluctance and dilatoriness on the "part of the whole Board." Even supposing this dilatoriness is eventually overcome, the scheme has to receive the sanction of the Local Government Board, which is not obtained for some few weeks—it may be months—and, as "The Times" put it, "the long-"suffering parish may be thankful if it does not have to "wait till some serious epidemic comes to wake up the "slumbering powers that be." This, according to the writer of the letter, was an exact description of the condition of things obtaining in his particular parish. For many years, only half the parish has had a proper water supply, furnished by one of the London Companies; the other half being served from surface wells, which run dry for nearly all the summer months, when a disused brick-pit has to be drawn upon by the kind permission of the owner. It appears that for some years the inhabitants of this part of the parish have been struggling to get a better supply of water, the present having been condemned by the

Medical Officer of Health as "quite unfit for domestic use, "showing a large excess of organic compounds owing to "the contiguity of the cesspools to the wells." We are assured that this is the position of affairs, notwithstanding that the Local Government Board have been appealed to, and the assistance of the local District Council solicited "times out of number;" further, that many of the poorer classes are so terrorized by the threats of the landlords to raise their rents if any water-rate has to be paid, that they speak "with bated breath" of their desire for good water. As extensive building operations are going on in the vicinity, there has necessarily been an influx of labour into the village, and all the available habitations have been filled up to the point of overcrowding; for, by what appears to an outsider as singular inconsistency, while the authorities have for some years persistently rejected the applications made to them for a better service of water, they prohibit the occupation of any new buildings which are not provided with a pure and abundant supply. The result is that the erection of suitable modern houses has been stopped, and the accommodation afforded by the cottages, which are said to be in some cases in a questionable state of repair, is overtaxed. "Here," says the writer of the letter, "is a plague-spot which may at any time burst out "into a hot-bed of disease." It will be well for the District Council to look to the condition of the village, in view of the possibility of its being brought under the notice of the Local Government Board in connection with the order referred to in the preceding paragraph.

The much-discussed question of the control of water supplies was the subject of an interesting address by Professor Glaister, of the Glasgow University, at the Annual Congress of the Sanitary Association of Scotland, recently held in Stirling under the presidency of Dr. A. Campbell Munro, of Glasgow. Starting with the proposition that all water supplies are liable to accidental contamination, he said the natural corollary was that they should be under rigid and continuous supervisory control. This being so, the points to be considered were the nature and extent of the control. He thought it should embrace knowledge of the natural history of the supply, inspection of sources, and chemical and bacteriological examination of the water at regular short intervals. Historical knowledge of a water would allow of a right estimate being formed of its fitness for a town's supply; while inspection, if entrusted to an intelligent person, cognizant of the usual modes of pollution, would facilitate the detection of causes of impurity. In regard to chemical and bacteriological examination, he expressed the opinion that the time had arrived for analytical results to be reckoned at their true value, as hitherto it had been pitched too high. Chemical methods had their limitations; while the present systems of bacterioscopic investigation, although accurate and reliable, as far as they went, were far from perfect. He urged that bacteriologists should formulate some definite line of examination of water, as chemists had done in regard to analyses. He strongly advised the purchase or lease of protecting areas.

Coming to the question of the powers of supervision and control over water companies which should be granted to local authorities, Professor Glaister very properly pointed out, as had already been done by others, that these companies are simply performing duties which the authorities ought themselves to have discharged, but have failed to do so, and that therefore care should be exercised that they should not be unnecessarily harassed by unreasonable proposals. At the same time he thought some alteration in the law was needed in this regard, in view of the fact that water is a necessary of life, and that a company possesses the monopoly of its supply in a given district. He expressed the belief that the clauses which have been drafted by the Local Government Board for embodiment in a General Act applicable to the whole country would meet the case; and he confessed to having no sympathy with the proposal to centralize the control of water supplies in a new Board, nor did he approve of the suggestion to establish a State Department of Public Health. He thought local authorities have already sufficient power in their hands to protect their water supplies. This same question of the control of water supplies, which has had to remain in abeyance in consequence of the more important matters occupying the attention of the Government, will very possibly be revived, with some other neglected home affairs, when the new Parliament meets "for the despatch "of business" early next year.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 791.)

THE condition of affairs on the Stock Exchange last week went from bad to worse. When we wrote last, they were suffering from depression, having had a severe disappointment; but worse was to come. The dissolution of Parliament has practically killed business; and it does not take much to kill it. All hope of any revival until after the elections are over is quite abandoned; and people are settling down in a resigned way, accepting the inevitable. Prices, of course, are all down. There was a bit of a fillip after the receipt of Lord Roberts's wire on Thursday; and things were fairly firm at the close, but they could not recover their lost ground. In the Money Market, short loans were met on easy terms; but rates for discount were harder. In the Gas Market, there was just as much restriction upon business as in any other department; transactions being on a very limited scale. But it had the advantage of immunity from the depression which characterized the markets in general. Where so little was done, changes in quotation are naturally few in number. But some of them were fairly large; and they all indicate a continuation of the tendency to recover from the low figures to which quotations were reduced when the great rise in the price of coal first took hold. At the same time, it ought to be borne in mind that it is in the current half year that the effect of the rise will press most heavily. In Gaslight issues, there was moderate business in the ordinary at good firm figures that seemed to justify a higher quotation; and the secured issues were fairly active too. South Metropolitan was rather quiet, and devoid of feature. A few transactions in Commercials were at good middle figures. Dealings in the Suburban and Provincial group were very limited, but at good prices. Crystal Palace further advanced. Southampton was set back; but that might have been done earlier. The Continental Companies, though quiet, showed out well; both Union and Imperial improving on their figures. There was nothing to notice among the remoter undertakings. The Water Companies were quiet and firm; and several issues made a further slight advance.

The daily operations were: Business in Gas on the opening day was very moderate; but the tone was good. Continental Union rose 2. On Tuesday and Wednesday, business fell away to very small proportions; and quotations did not vary. Thursday was no better in point of activity; but Imperial rose 1. Southampton was put back 5. Friday was a shade more brisk, and quite as firm. Union had a further rise of 3. In Water, Chelsea and Southwark rose 2 each; and East London, Lambeth, and West Middlesex gained 1 each. Saturday was fairly active, and very firm. Crystal Palace improved 3.

ELECTRIC LIGHTING MEMORANDA.

The Combination of Cable Makers—Suggestions for Standardization—A Paper on Electrolysis—The Woes of Manchester.

IT is an old complaint of the electric engineering profession that while the engineers and electricians do all the work of developing the industry, the cable makers take the lion's share of the profit on every job. Consequently the cable maker has been injuriously likened to Brer Rabbit, who commonly found his advantage in "lying low and saying nuffin';" to the proverbial still swine who eats up most of the draff; and so forth. The design and construction of dynamos, questions of "phase," of lamps, of meters, and all the numerous technical problems which exercise the electrician and fill the professional journals, are naught to the cable maker, who simply takes orders and pockets his profits. His is the only branch of electrical trade which has kept above water throughout the stormy periods that have supervened since cables began to be required for other than telegraphic purposes. Naturally, the others are sore about it; but they cannot help themselves. The manufacture of insulated cables is not everybody's business. It is in few hands; and those in the trade have been able to make their own terms. This circumstance has not prevented the purchasers of cables for different purposes from following their own fancies in regard to the design of these conductors; and some of them have been fearfully and wonderfully made. A volume might be filled with descriptions of the various patterns of electrical conductors actually made to order during the past twenty years, ranging from Dr. Kennedy's plain, bare copper bars to the newest rubber-substitute insulated wire.

Now, after all this experience of the fancies of consulting electricians, the cable makers have formed themselves into a league, and put forward a suggestion for the standardization of cable specifications of which the outside profession hardly knows what to think. In so far as the action of the cable makers favours legitmate standardization of means and requirements, there is obviously no objection to it. Besides, they were the only people who could do it. Clients and contractors alike have suffered in the past from the vanity and the ignorance of self-styled electrical engineers, who were more successful in touting for business than in carrying it through. Judged from the commonsense, commercial standpoint, it might be difficult

to say which is the greater nuisance—the pedantic electrician who works out the dimensions of his conductors to four places of decimals, and scorns to recognize any stock dimensions and patterns, or the ignorant pretender who does not care what he promises so long as he gets a job into his hands. It is equally difficult for the cable maker to work satisfactorily with either. The step taken by the associated cable makers should be a salutary check upon both these troubles of the trade. It will place the makers in a position to decline orders that do not come within the very wide scope of what their experience teaches to be legitimate. Naturally enough, the suggestions of the makers go a little beyond what might be esteemed on all hands the strict necessities of the trade. Thus, they desire to free themselves from the common contractors' obligation to submit to the engineer's decision as final, and propose an arbitration clause in specifications. This is a general question of engineering contracts which cannot be summarily disposed of with special reference to one class of business. We have had previous occasion to discuss the point on its general merits, and therefore need not go into them here. Suffice it to remark that a consulting engineer who knows his position, and is determined to do his duty, will never consent to be bound to order payment for what his judgment tells him his client does not want. If a contractor has reason to distrust an engineer, he can decline to tender to his specifications.

The current number of the "Electrician" contains the text, with illustrations, of a valuable paper by Mr. Dabney H. Maury, of Peoria, on the electrolysis of underground metal structures, due to the operation of electrical street railways. Mr. Maury has been, since March, 1893, Engineer and Superintendent of the Water-Works of Peoria, Ill., and has therefore lived right through the period of electrolytic disturbance. The trouble first showed itself by the remarkable frequency of service-pipe bursts, although the lead piping was of extra strength. Then the cast-iron mains became affected. Interest soon concentrated on the joints of tar-coated mains; and Mr. Maury instituted a series of experiments, the results of which he gives, to determine the nature and extent of electrolytic currents on spigot-and-socket joints. Broadly speaking, the teaching of experience in this regard is that cast-iron mains cannot convey electric currents without injury. It is wholly a question of degree. The owners of such pipes can do nothing to protect themselves. Those owning the electric tramways must bear the entire responsibility. It has been proposed by some electricians to take the bull by the horns, and make electrical connection between the return wires and the pipes, thus converting the latter into part of the electrical system. Mr. Maury objects that, although this expedient would certainly lessen the amount of mischief done in what are recognized as dangerous areas, it would eventually lead to the breakdown of the entire pipe system, beginning, perhaps, at points remote from the original cause. He also denies the utility of any such device as an "insulating joint," or "insulating section" of pipe. In order to be effective, he says, the whole system would have to be made of some non-conducting substance, as stoneware; because a really dangerous current can get round a length or two of pipe just as easily as it passes by the smaller obstacle of a yarn joint. The real difficulty arises from the fact that not even a continuous rail can be relied upon to carry the return current without leakage. "The rails are not insulated from the ground; and the pipes would still carry, and be affected by, a large portion of the current, as is clearly shown by numerous electrical surveys and reports of serious damage in cities where the best tracks known to modern science are in use." In conclusion, the author recommends the double-trolley or conduit system as offering the only perfect means of keeping current out of the ground and preventing electrolysis.

Manchester has lately had its fill of electrical troubles. Following hard upon the accidental destruction by fire of the central telegraph station, came a mysterious collapse of the municipal electric lighting, which completely broke down at about 8 o'clock on the night of the 19th inst. No particulars of the mishap have yet been published; nor do we know how soon the service was restored.

METHODS OF ADVANCING THE WELFARE OF THE WORKING CLASSES.

[Second Article.]

In the opening article we summarized and commented on the account given by Dr. Gilman (in his book "A Dividend to Labour") of some among the most noteworthy of the efforts made by employers in Germany to advance the welfare of their workpeople, and to create that bond of friendly feeling between man and master which is worth a king's ransom to a business. We have now to notice Dr. Gilman's record of schemes instituted by employers in this country in the hope of achieving the same results. Many of the schemes are on the same lines as those adopted in Germany; and we need not go again over the ground already covered. But, generally speaking, it may be said that the employer in this country does less for his men in the way of organizing their home life, their pleasures, and their methods of thrift and providence, than does the Continental, especially the German, employer. The explanation of this state of affairs is not far to seek. It lies in the fact that in England the working-classes, having greater freedom, and being better educated and more intelligent, have done much for themselves by organization—through the agency of trade unions, co-operative stores, and friendly societies—that the Continental employee needs to have done for him, or it would never be done at all. Moreover, the English workman, by very reason of his superior intelligence and greater political liberty, is far too independent in spirit to care to have too close heed paid to the conduct of his private life and affairs by his employer or any other outside person. He is strongly imbued with that spirit which well-meaning, but officious, persons often encounter in their kindly efforts to teach all mankind (or womankind) its business—namely, the spirit of preferring to manage one's own business indifferently, rather than allow other people to manage it for one, be it never so well that they could do it.

Nevertheless, there are many directions in which the employer in this country can be of assistance to his workmen without in any way running counter to that spirit of independence, and in no way more than by giving to them, in the management of the various provident or other clubs to which they subscribe, the benefit of business and financial experience, which he and his principal officials naturally possess in a more marked degree than any workman can—though, even here, care must be taken not to give the impression of desiring to dictate. Men are very apt to imagine—and the Friendly Societies and Trade Unions do nothing to lessen this aptitude—that clubs connected with their firm, and on the management of which the firm is represented, are run really in the interests of their employers rather than in their own. Where such a belief exists, no good, and sometimes harm, will accrue. Whether it exist or not depends very largely upon the amount of tact displayed in offering and giving the assistance; and it is, of course, as impossible to teach tact as to impart taste to those who possess it not. We merely wish to throw out the hint that, in such matters especially, how a thing is done is often of more importance than how much is done.

Dr. Gilman instances the efforts of numerous firms as proving that English employers have shown interest in their employees in "an admirable and comprehensive fashion." First among these is the firm of Lever Brothers, whose village of Port Sunlight, built for the accommodation of their workpeople, is well known to many by repute, if not by actual acquaintance. A number of the houses in the village were practically given to the men as a form of profit-sharing; the rent being gradually reduced to the nominal figure of 10 per cent. of that originally charged, and the firm, moreover, undertaking the maintenance and repairs. This system is not now continued; it being considered "that living almost rent free would impair the workman's feeling of self-respect and independence"—an argument which hardly appears conclusive, as the man would, it seems to us, feel he had earned the right to so live. We may take it, however, that Messrs. Lever found from experience that their original plan was not best calculated to ensure the successful working of profit sharing; and one of the most valuable features of Dr. Gilman's book is that it is a record of experiments actually made by practical men, and tells therefore of failure to avoid as well as success to emulate.

The cottages at Port Sunlight are lighted by gas, and have each at least three bedrooms, as well as a bathroom—a great and much-needed improvement on the ordinary workman's house—and a garden. A tract of land is let out in allotments for kitchen garden purposes, at very moderate rental. The houses, be it said, are not simply the brick boxes made by the score, and all of a hideous sameness, which constitute the ordinary working-class quarter, but red brick and half-timbered structures of varied architecture. The proverb that "God made the country, man made the town, and the devil made the big town," always recurs to one when passing through the miles of squalid dreariness that are to be encountered (say) in some of the outskirts of London. The depression that pervades the atmosphere of such mean streets is enough to drive men to drink and crime; and no employer can do a truer service to his men than to give them the chance to rent houses which it is not a mockery to call homes. There are, in the village of Port Sunlight, various clubs and institutions—bowling alleys and billiard, smoking and concert rooms—which were originally founded by the firm, but are now self-supporting and are managed by their own committees. "There is no public-house in the place." The hours are 44 and 48 per week for women and men respectively; a system of premiums on wages is in vogue; and "in all the departments wages are higher than elsewhere in the district."

The most noteworthy feature of the various schemes in force for the benefit of the employees of the well-known printing firm of Hazell, Watson, and Viney—who have tried, but abandoned, a system of profit-sharing—is the plan for facilitating the acquirement by the workmen of shares in the concern. Arrangements are made by which the men can purchase shares by means of weekly instalments of one shilling, receiving dividends thereon from the date of their first payment. The share, therefore, eventually becomes the man's property for payments (less dividends) equal to only three-quarters of its market value; while it is provided that if a man dies "at any time after paying the first instalment, his family own the share without further payment." When all the instalments are paid on the shares now in process of being acquired, the value of the capital held

by the men will be close upon £30,000—"no small part of the capital required to work the concern."

Messrs. Hazell, Watson, and Viney have, as we have said, instituted many plans for furthering the welfare of their men. Most of them are similar in character to those we have described as in operation in other employments. We will only now mention the fact that the Directors subscribe for a number of letters for convalescent homes, hospitals, and medical aid societies. This is a course adopted by the directors of numerous large concerns—certainly by many, and we hope by most, of the principal gas companies in this country, and is in every way commendable. The provision for sending deserving cases to homes by the sea or in the country, in order to render recovery from debilitating sickness more complete than it can possibly be made in town dwellings (often none of the most healthy), is, as has previously been urged in the "JOURNAL," one of the most truly profitable forms of expenditure. The difference between the quantity and quality of the work done by the man who crawls back to duty so soon as he can get out of doors, and of that turned out by the man who is not allowed to come back until fresh air has put fresh life into him, will soon repay tenfold the cost of sending the second man away for a fortnight or three weeks. We may also note that "the Company encourages its apprentices to acquire a good technical knowledge of their business, by allowing them to attend, in business hours, classes conducted by certain technical institutions in London, they being paid as if still at work."

No list of employers who have sought to improve the condition of their workpeople would be complete that did not include the name of Cadbury Brothers, the senior partner in which—Mr. Richard Cadbury—died last year. To his private generosity alone Birmingham owes about £70,000 worth of buildings, in the shape of "a great educational institution for the working classes, a convalescent home for children, and various provisions for the aged." The works of the firm at Bournville are, as all will bear testimony who have had the pleasure of visiting them, a perfect model of comfort and health for the employees; while the houses built for their accomodation are most attractive, yet are made to pay interest on their cost out of a five to six shilling rent. The gardens attached average about one-sixth of an acre—which makes the Londoner sigh with envy.

The firm of Sir W. G. Armstrong, Whitworth, and Co., of Elswick, combines the encouragement of thrift with a kind of profit-sharing, by receiving deposits from the employees or the officials in sums of not less than one shilling nor more than one pound (in the case of officials two pounds) per week, and adding thereto not only 4 per cent. interest, but also "a bonus equal to half the difference between the fixed rate of 4 per cent. and the dividend payable on the shares of the Company." The firm also take much interest in the education of their employees. There are connected with the works "a mechanics' institute, a day school with a science class, and a night school mainly for apprentices, with classes in mathematics and natural science. These have enjoyed the patronage of the heads of the concern, and have had very excellent results."

Dr. Gilman's account of English employers' efforts for the welfare of their men comes to an end with a description of the provident funds connected with the great railway companies, which are run upon familiar lines. We have left ourselves no space to touch upon Part III. of his book, dealing with profit-sharing, which we must consider in a further article. We have, let us hope, quoted sufficient from Dr. Gilman's account of concrete efforts that have been made to attain the abstract ideal which he set forth as realizable by the employer, to give our readers an adequate conception of what can be, and is being, done both in this country and abroad to raise the level of the relationship between employer and employed. In Dr. Gilman's words:—

> The employer who would proceed with animation, but with moderation, on the line of a practicable advance, has now before him the record of the experience of many such men as himself who have . . . made a highway in the social wilderness for him. Realizing, from the purely financial standpoint, that the human equipment of a factory is at least as important as the mechanical equipment, these sagacious men have provided for its maintenance at the highest point of efficiency. The employer is "made of social earth," as well as his operatives; and welfare-institutions for their benefit, undertaken merely from long-sighted prudence, can hardly fail to bring him nearer, as time goes by, to a living sympathy with these men and women of like passions with himself. An employer who concerns himself to house his helps well, and gives them the benefit of his capital, used in buying land on a large scale, laying it out with a view to health and beauty, and purchasing building material for them at wholesale rates, may be very unconscious that he is a social reformer. None the less, though quite independent of legislators, and even distrustful of "theorists," he is doing more to establish democracy on its necessary moral basis, and to bring in the Kingdom of God, than the social enthusiast whose large projects meet a fatal enemy in human nature.

We can only hope that Dr. Gilman's book will have the wide circulation among employers that it deserves.

The Temperature of Acetylene Flames.—The maximum temperature of an acetylene flame has been given by M. Le Chatelier as from 2100° to 2420°; by Professor V. B. Lewes as 1517°; while Professor Smithells's figure is somewhere between the above. Mr. E. L. Nichols, in a paper read before the American Physical Society, gives the temperature in the middle of the flame as 1900°, and at a distance of 1 mm. from the middle 1920°. The highest temperature obtained from a luminous coal-gas flame with the same apparatus was 1780°, and from a candle flame 1670°.

THE BRITISH ASSOCIATION AND MUNICIPALISM.

[SECOND NOTICE.]

LAST week we explained, with a running commentary, the nature of the case for unlimited municipalism which Mr. Arthur Priestman laid before the British Association meeting at Bradford. We showed how his ruling idea was that private enterprise should be wholly excluded from every kind of employment embraced in organized town services and supplies, and how he ignored every objection to a rule of Municipal Collectivism. Mr. Priestman was immediately followed by the Hon. Auberon Herbert's paper on "Municipal Building for the Overcrowded," which set out the opposite view, that unnecessary municipalization (which is another name for compulsion), is to be avoided. Mr. Priestman, although a man of much experience in municipal business, was the theorist, the dreamer. Mr. Herbert, the detached and somewhat eccentric philanthropist, was concerned with the practical effect of government on the parliamentary model, by the conflict of majorities with minorities. The difference of the two voices expresses the irreconcileable divergency of the two ruling political parties which divide all civilized commonwealths. The one party sets much store by names, principles, and professions. Its followers easily persuade themselves as to the sovereign efficacy of certain forms of government and systems of administration. So long as a "programme" can be classified as democratic, or parliamentary, or progressive, they accept it blindly for themselves, and make believe that it must be good for everybody at all times and in all circumstances. The other habit of thought is less gracious to the outward view. It is largely influenced by ever-present remembrance of human frailty, and is consequently forever inquiring how things work, regardless of what they are called.

Mr. Herbert, whatever his political profession, is one of those who submit even the parliamentary idea of government to the test of experience. He perceives that the rule of majorities is hard on minorities, and is apt to degenerate into administration by machine. The theory of democracies is that the people rule themselves by their chosen representatives; the practice is that the minds, the bodies, and the property of all are at the disposal of the victorious section. Happily, the innate honesty of the English character, its impatience of logical formularies, and the sportsmanlike appreciation of fair play which appears to be an English peculiarity, help to keep English national and municipal institutions healthy. Hence, as Mr. Herbert says, we must look abroad for the worst examples of the failure of what is facetiously termed "popular" government. "What a chronicle of extravagance and corruption has met our eyes in many cities of other countries! What violent partisanship in the Paris and Vienna of the present hour! What organized illegality in New York! What desperate remedies in the suspensions of the right to govern themselves in the cities of America!" Mr. Herbert's suggestive preventive against the infection of British municipalities with this kind of poison, is to preserve and develop the voluntary side of municipal service. "We cannot go on for ever slipping and sliding against our will into Socialism; we must learn to meet great wants in better fashion—the fashion of men who are not compelled. . . . So long as we satisfy every new want by the easy and idle methods of compulsion, we learn nothing; for compulsion leaves all faculties undeveloped, and only deepens the courses of strife."

The note of common sense and practicality was struck, between these discordant voices, by Mr. E. Bond, whose name has been mentioned in the "JOURNAL" as that of an authority on the housing of the poor. He is Chairman of a joint-stock Company who actually make a living profit out of the rents of the humblest class of good industrial dwellings, which is more than most municipal corporations can do. Mr. Bond laid down the rules, hitherto esteemed good and valid, by which the question of the expediency of municipal action in any particular may be determined. "They were all agreed that a municipality should look after the health of its population, should see that the streets were properly paved and lighted, and should exercise a large number of multifarious functions depending to some extent on local circumstances; *but not in any case for the sole purpose of making a profit*." The supply of water is typical of the kind of enterprise, exceeding the primary and imperative functions of local government which a municipality might reasonably undertake. Among the reasons cited by Mr. Bond as justifying this addition to the responsibilities of a local authority—as the necessity of water, the absence of risk in the management and financing of a town's supply—he omitted the most potent of all. This is the consideration that the due apportionment of the water resources of the country, which cannot be increased, but can certainly be husbanded, is become a matter that transcends the range of private interest.

As regards other subjects which are being too lightly regarded as suitable for municipal appropriation—such as gas and electricity supply—Mr. Bond has reasonable doubts. He pointed out that if municipal gas or electricity, were to turn out a failure for any reason, the municipality would be in a difficult predicament. Even in the modified way in which the Bradford Corporation gas business has failed this year—failed to return the "usual profit" for relieving the rates—the circumstance has induced Mr. Priestman to contemplate a step which would be jumping out of the frying-pan into the fire. A municipal coal

mine is wanted to ensure the relief of the rates out of gas profits. This reads like an absurdity; but it is a statement of fact. Mr. Bond justly declared that the whole idea of municipal trading was that of making a profit. At the bottom of it lies the presumption that "persons who had no special knowledge of the kind of business entered upon were perfectly capable of undertaking the control of any business simply because they were called a municipal corporation." The truth is otherwise. Mr. Bond can speak for the London County Council, of which he is a member; and he avows that the mass of work thrown upon this body is already so great that only a very small part of it can be properly understood by any one member. The result is that reliance has to be placed more and more upon the paid staff, the individuals forming which may not always be competent and honest. Therefore is Mr. Bond desperately against any considerable enlargement of the scope of municipal trading. "So far from sharing Mr. Priestman's view that the health, wealth, and well-being of the community would be advanced by the extension of municipal enterprise, he was of a directly opposite opinion. He believed that municipalities would find themselves in a financial muddle if they went much further on these trading lines. There was no reason to believe that articles of general consumption could be supplied cheaper, better, or more suitable by the municipalities than they could be supplied by private enterprise," while, of course, no choice is open to the customer of a municipality. The municipal corporation who go into trade abdicate their right of supervision of the trade in the public interest. The mediæval ale-taster was not a beer-seller.

Professor Silvanus Thompson intervened in the discussion with a mild reminder to Mr. Priestman that electricity supply is not the parochial affair that Bradford and other towns have hitherto made of it. He jibed the Corporation for their mismanagement of the local tramways—in keeping to the old local narrow-gauge lines because there were a few antiquated cars to be worn out. This reproach, if just, bears out what has been often remarked in the "JOURNAL" concerning the reluctance of local authorities to "scrap" obsolete plant. A speaker who challenged a hearing by the sheer weight of his matter was a Mr. J. H. Levy, who carried the campaign into the enemy's country by declaring, against the presumption of the paper, that monopolies hardly ever pay, in the best commercial meaning of the term. Of course, in the case of a municipality holding a monopoly, it could be made to pay by the exclusion of all competition, and charging a higher price for the services rendered than would be charged by private enterprise. This is a view of municipalism not likely to please the ardent municipalizer; but Professor Gonner lost no time in pressing its consideration. He would have nothing to say in favour of municipalizing the supply of necessaries of town life, or any other false generalization respecting the kind of services that may be monopolized. A monopoly is an economic expedient for getting certain services performed which cannot be so satisfactorily done under other auspices. It is not a question of whether the services are necessary to life, or whether they are large or profitable. It is a question of the sinking of capital, and of establishment expenses. Two national postal services are unthinkable; and so are two distinct tramways in one street. This is the aspect in which to place the question of monopoly or competition. Professor Gonner confessed that he did not like to see municipalities taking up with trading merely for the sake of the profit of it. This should not be the inducement at all. Mr. H. Wilson followed on the same side. He also pointed out that municipal trading in England is an affair of very recent growth; and its character for success has therefore depended altogether on the ability and integrity of those individuals who had inaugurated the various schemes, and had seen to their execution. There remains the danger that the management of these enterprises may fall into improper hands, with the same result as that rendered familiar by American experience.

Dr. Hime also came down very heavily on Mr. Priestman for his Socialism—declaring that the presumption of the success of municipal trading had no justification in the history of the world. Individual rivalry and trade competition is a fruitful source of individual misery; but there is no adequate proof that the human race would have risen to its present degree of civilization and development without anxieties, wants, trials, dangers, and sufferings. The municipalization of everything meant, to Dr. Hime, the control of everybody by the Corporation Inspectors, who are a class of men often unfit for their duties. This prospect did not please him. These high theories so commonly pass out of sight behind the commonplace agent through whom they operate in the last resort!

On the whole, therefore, it cannot be truthfully said that the cause of municipal progress in the direction of trading received much encouragement at the Bradford meeting of the British Association. Doubtless, if some of the smart young journalists who do the newspaper puffing of the Progressive Party in London and other large centres had been at Bradford, they would have been as facetious at the expense of the cautious old individuals who were generally averse to turning the Town Hall into a general dealer's shop, as they usually are in the acknowledged "organs" of the Party. They were absent, however; and Mr. Priestman stood alone for his cause. It would be flattery to say that he advanced it materially.

Meanwhile, before concluding this notice of the subject, it is very much to the point to mention that the Blue-Book containing the "Interim Report" of the Joint Committee of Parliamenon Municipal Trading, with the minutes of evidence, has been issued. It is a mine of interesting information, naturally more distinctly focussed in support of various opinions than evidence of facts. The volume is worth getting, if only for the evidence of Sir Benjamin C. Browne, Mr. Livesey, and other men of affairs who freely gave the Committee their views of the guiding rules, not merely of municipal trading, but also of the main principles discerned by them in the development of the national industries. It has been the cue of a certain brand of politicians to sneer at the Joint Committee on Municipal Trading; but although the title of the Blue-Book which records the fruit of the labours of the Committee up to the present time is not a taking one, it is better worth studying than most text-books by anyone who is curious in respect of the multifarious subjects spoken of by the numerous witnesses called. It is one of the most valuable aids to the effective criticism of the matters to which it relates that has ever been put into the hands of the public. The appendices are alone worth the price of the book.

THE POSITION OF THE IRON AND STEEL TRADES.

AN incident significant of the present very peculiar condition of the iron trade has just occurred in Glasgow, when the Secretary of the pig-iron ring was presented by the members with a pair of white gloves to commemorate an event which had not previously happened for many years—namely, that not a single transaction took place that day at the meeting of the Glasgow iron market. The outlook in the iron and steel trade grows, in fact, more gloomy, and the future more difficult to accurately forecast, with the passing days. The ironmasters have to face, on the one side, the facts that orders on hand are being executed at a greater rate than new orders are being received, and that foreign competition is becoming daily more assertive; and, on the other, a greatly increased cost of production, both on account of the really tremendous price of coal and of the present high rates of wages.

That orders of sufficient magnitude to replace those in process of execution are failing to come in, cannot be doubted, and is, of course, only what was to be expected, as consumers naturally are restricting their requirements to the lowest possible figure, rather than buy at present prices—especially those whom we may describe as "ultimate" consumers, by which we mean buyers whose purchases would be in the nature of capital expenditure. For such, buying at present prices means laying on their undertakings a permanent handicap. Prominent in this class stand the shipowners; and, though the activity of trade has had the effect of sending up freights, there are two considerations that give pause to those who contemplate giving out orders for new ships just now. The first is that bunker coal is so dear as to largely discount the higher freightage receipts; the second, that the activity of trade is obviously diminishing rather than increasing.

Not only, however, are the shipbuilders of Scotland and Ireland obtaining a less volume of orders, but no small quantity of the material wherewith to execute those they do receive they are buying, not in the home, but in the American market; and a considerable increase in the imports of ship-plates and other structural materials from the States will certainly be shortly witnessed. Reports are, indeed, in circulation as to the purchase of from 50,000 to 100,000 tons of steel from American houses; but we shall require the evidence of the Board of Trade statistics before placing absolute reliance on figures which may be invented for market purposes. There can nevertheless be no doubt that with the prices of iron in the States much below those in this country, and showing signs of falling lower still, American material will be increasingly used for structural purposes here, unless a marked change comes rapidly over the coal market.

For it is, we need hardly say, the price of coal that is the main, if not the sole, cause of the growing depression in trade generally, and in the iron trades in particular—not only in this country, but in others. Germany especially finds herself in much the same boat as ourselves. The irony of the situation is that it was the activity of trade everywhere that produced the "boom" in coal; and now, boomerang fashion, it is the price of coal that is checking the activity of trade. And, of course, the check to trade will in its turn bring down the price of coal. So we go round like a dog after its tail. What most people want to know is, What gave the originating impulse to trade? It is always dangerous to dogmatize on points so obscure as this; but we have before now expressed our belief that it is to the general expansion of the world's navies that we may look for the *causâ causans* of the industrial activity of the past few years. And a trade revival based upon the non-productive expenditure of taxes is necessarily so artificial as to be of but short duration. The enormous growth of trade in America cannot, however, be put down to naval construction; for that is, comparatively speaking, but in its infancy in the States. There the general increase of business has resulted from the rapid but natural development of the nation—the higher standard of living, and the exploitation of the resources of the country.

From whatever cause the recent trade revival sprung, the gas

industry has suffered heavily from its effects, and cannot view the prospect of a return to less exciting and more humdrum times in the industrial world with anything but relief. If, however, the present time of adversity should result in the introduction or stricter observance of economy, and the cultivation of a greater spirit of enterprise, in the conduct of the affairs of gas-works undertakings, good will have, as it is always said to, come out of evil.

AN ENGINEERING RECORD OF THE PARIS EXHIBITION.

LAST month's number of the "Engineering Times" was specially and entirely devoted to the engineering exhibits in this year's Paris Exhibition. It forms a handsome book of nearly 300 pages, and is profusely and admirably illustrated. It will prove of considerable interest to the many gas engineers who have visited the Exhibition—serving to remind them of much they may have seen; while for those who have been unable to go to the greatest Industrial Exhibition the world has yet seen, it will suffice to bring before them its chief technical novelties and attractions.

The interesting editorial introduction opens with a brief historical review of Exhibitions, dating, in modern times, from the year 1797, when the Marquis d'Avèze organized a display of the three principal French government manufactories—the porcelain of Sèvres, the tapestry of the Gobelins, and the carpets of the Savonnerie. The seventh National Exposition, held in the Louvre in 1827, was the first in which the steam-engine played an important part; while that of the year 1844 was remarkable for the heavy moving machinery exhibited. The present Exhibition marks the tremendous strides that have been made within the past hundred years, and forms the starting-point for the further advances of the Twentieth Century.

The great enterprise and keen competition of Germany is one of the most striking facts that is brought home to us from a visit to the 1900 Exhibition. Not that the comparison between the German and British exhibits justly represents the proper position of each in the industrial world; but this is the conclusion—erroneous though it may be—that many foreign visitors will come to. How can it be otherwise when Germany voted a grant of £250,000 to represent her at the Exhibition, and Great Britain only £75,000? Even more convincing than this is a glance at the number of exhibits for which each country is responsible. France naturally leads the way with 30,000, followed by the United States with 6564, Belgium with 2500, and Germany with 2000—the same number being also attributed to Italy. Great Britain (bracketed, if you please, with British Columbia) figures with 600! being beaten also by Russia, Scandinavia, and Austria. It cannot be doubted but that such poverty of representation on the part of Great Britain will exercise a depreciating influence, and have a baneful effect, on its future commerce. Strong animadversion is passed on our Royal Commission for the "half-hearted, spiritless manner" in which it has performed its duties.

There are many interesting pages, with beautiful photographs, dealing with subjects that do not fall within the immediate province of the "JOURNAL," such as railway locomotives, steam-engines, and machinery of various kinds and for various purposes. Modern electrical plants are also dealt with, and would repay examination. Let us, however, notice those branches and those exhibits in which our readers are more particularly interested. There are two chapters on "Oil and Gas Engines." Of the former, the largest one shown is of 40-horse power, known as the "Hornsby-Akroyd." There are others, of which details are given—such as the Cundall, Dudbridge, Campbell, Priestman, and Ruston engines. The oil-engine of Messrs. Blackstone and Co. is easily converted into one for the use of gas. Its oil reservoir is in the foundation casting of the engine; and it is stated that the cost of working a 14 brake horse power engine, with oil at 6½d. per gallon, is 0·588d. per brake horse power per hour. A portable engine of the same make is also illustrated. With regard to the show of Messrs. Crossley Bros.' gas-engines, it is complained that it cannot be regarded as really representative; for, owing to lack of space, only their smaller-sized engines are exhibited. Special "Campbell" gas-engines for electric lighting are described; and the consumption of Halifax gas in one of 34 brake horse power proved to be 15·4 cubic feet per brake horse power per hour. Of course, mention is made of the 650 brake horse power Westinghouse gas-engines in use; and a view is given of a three-cylinder engine connected directly on to a dynamo. Illustrated details of its working parts are also shown, and its action explained. The "hit-and-miss" principle of gas-engine governing has been done away with; the number of explosions always being the maximum, whatever may be the engine load. With a reference to the carburetted air, gas, and oil engines of Messrs. Dougill, this portion of the Exhibition is concluded. Analogous to it, however, is the consideration of "Blast-Furnace Power Machinery." An admirable full-page illustration of a 600-horse power blast-furnace gas-engine, made by the John Cockerill Company, of Seraing, Belgium, is given; and this exhibit is one of the most important novelties of the Exposition. The engine has only one cylinder, 51·18 inches in diameter, with a length of stroke of 55·15 inches. Tests were made on it, before leaving the makers' works; and, in the presence of an International Committee of experts, it was found that it developed 900 indicated horse power, with a consumption of 100·8 cubic feet per hour. The gas used was delivered from five Bessemer blast-furnaces. The engines and apparatus of the Blast-Furnace Power Company are also fully described; and the means to be adopted for utilizing blast-furnace gases in gas-engines are dwelt upon. The great economy that may be made by such employment is emphasized.

One article is devoted to "Gas Exhibits and Lighting." It is contributed by Mr. C. E. Brackenbury, Assoc.M.Inst.C.E. After describing the Gas Pavilion, and the general arrangement of the exhibits, attention is called to models that are of interest to gas engineers. There are situated close at hand to one another three models of settings of inclined retorts—an unpretentious one by Messrs. Graham, Morton, and Co., Limited; a more ambitious one by the Société de Cornues Inclinées; and a more imposing one still by the Stettiner-Chamotte-Fabrik. These represent the ideas on this carbonizing question of English, French, and German. The approximate cost of the models may be taken respectively at £50, £400, and £3000! The differences between these figures may be considered in the light of what has already been said on German enterprise. The writer of the article, however, pointedly asks: "What about their merits, not as examples of the model-maker's art, but from the point of view of the practical gas engineer?" Reference having been made to the well-placed exhibits of French firms, Mr. Brackenbury inquires, "Where are the stalls of our English manufacturers of gas plant? . . . Where may gas engineers of other nations find our latest and best example of exhauster? Where our washer-scrubbers? Where may models of our admirable purifier valves, and one-hundred-and-one other things be seen? And where do we show our acknowledged superiority of gasholder workmanship, and our up-to-date columnless holders? Where? *Nowhere!*"

Among miscellaneous appliances of interest to gas engineers, mentioned in this admirable engineering record of the Paris Exhibition, may be cited the well-known Temperley Transporter, a good working model of which was on view, and soon met with an offer of purchase. It showed a travelling tower transporter, by means of which apparatus coal can be lifted from a vessel, carried along the beam, lowered, and deposited, and the empty skip returned, within the space of 45 seconds. Avery's automatic weighing machine is also described and illustrated; and its successful working with coal is recorded. Among the "Instruments of Precision and Measurement," we find mention of the platinum thermometers, or pyrometers, made by the Cambridge Scientific Instrument Company, Limited, to which attention was called by Mr. Leather, of Burnley, in the discussion on Mr. Alten S. Miller's Congress paper on the "Measurement of High Temperatures." (See *ante*, pp. 631 and 643.) Their advantages are stated to be: The varying positions in which they can be used; the measuring of temperatures as high as 1200° C.; the placing at a distance of the indicator (of which a photograph is given); and lastly, their accuracy.

Although, naturally enough, but a small part of the work reviewed deals directly with gas and subjects connected therewith, yet enough has been said to show that it contains matter of considerable interest to all connected with the gas industry, and it forms, as it claims to be, a valuable and permanent and attractive scientific engineering record of the Paris Exhibition of 1900.

CHEMISTRY APPLIED TO GAS LIGHTING.*

GAS Lighting deserves a foremost place in any work on Chemical Technology; and we are glad to find that its claims have been adequately recognized by Mr. C. E. Groves and the late Mr. W. Thorp in the volume which is now before us. The Publishers and Editors, moreover, must be congratulated on having been able to secure the invaluable services of Mr. Charles Hunt in the preparation of this section of the work. Mr. Hunt needs no introduction to readers of the "JOURNAL;" and we will therefore at once proceed to indicate the manner in which he has dealt with his subject.

"Gas Lighting" has been interpreted in a liberal spirit; and the volume treats of the manufacture of gas, as well as its application as an illuminant. Chapter I. covers the early history of gas manufacture, and concludes with a brief exposition of the sliding-scale enactments. Some statistical information is quoted from the Board of Trade returns for 1898, with the object of showing the magnitude of the operations of large gas undertakings. Chapters II. and III. contain a general account of the process of gas manufacture, and notes on the composition of gas coals, of which several pages of analyses—many taken from "King's Treatise on Coal Gas"—are given.

We then come to the important chapter on carbonization, which is very well treated. It is explained that the portions of coal in a gas-retort, which are actually undergoing decomposition, are probably always at a temperature of about 400° C. (752° Fahr.), and the primary products of the decomposition are the same, notwithstanding wide variations in the temperature

* "Chemical Technology, or Chemistry in its Applications to Arts and Manufactures." Edited by Charles Edward Groves, F.R.S., Lecturer in Chemistry, Guy's Hospital, and William Thorp, B.Sc. Vol. III. "Gas Lighting." By Charles Hunt, Engineer of the Birmingham Corporation Gas-Works. London: J. & A. Churchill; 1900.

of the retort. It is only on these products that the full heat of the retort comes into play, and produces secondary products, the nature of which varies with the heat of the retort. In order to illustrate the effect of increasing temperature on the gas produced from a particular coal, the results of nine trials are quoted; but assuming that the make and illuminating power are correctly stated, the "candles per ton" given are miscalculated or misprinted in four out of the nine examples! It is, of course, impossible, in the case of the majority of the figures in the book, to test their accuracy in this manner; but if anything approaching such a degree of error prevails generally, we think the whole of the present edition should be withheld from sale pending correction and revision.

Strangely enough, stopped ascension-pipes and naphthalene obstructions are not dealt with in this chapter, but later in the work, in connection with service-pipes, where we are told: "High heats, then, appear to be accountable for the following: (1) Reduction in the quantity of light oils, by reason of the formation of naphthalene, &c., from decomposition of benzene, &c.; (2) stopped pipes, resulting from a deficiency of light oil; (3) withdrawal of light oils from the gas, consequent on the necessity for removing naphthalene, thus involving considerable loss of illuminating matter." Surely such a summary of the effects of high heats ought to have been given in connection with carbonization rather than services.

When dealing with the nitrogen products of carbonization, the author states that it is a curious fact that the amount of cyanogen obtained on the Continent is, as a rule, much higher than that obtained in this country, probably on account of higher temperatures there used in carbonizing. We hope he has really assured himself that the amount of cyanogen *produced in carbonization* is higher on the Continent before making this statement, and that he has not been guided only by statements of the amount of cyanogen *recovered* from the gas. Curiously enough, English coal is believed to afford a higher yield of cyanogen than most of the Continental coals; and therefore the amount made per ton of coal on English works ought not to fall short of that made on the Continent. But, as we shall have occasion to point out later, the author does not appear to be very familiar with cyanogen recovery, even as it is practised in this country.

Chapters V. and VI. treat of retorts and furnaces. Good illustrations are given of several regenerative furnaces—*e.g.*, the Schilling, the Liegel, the Klönne (and Hunt's modification of it), the Siemens, and Valon's. We have, however, failed to find any general account of the actions which take place in generators; and technical terms such as "primary" and "secondary" air are freely used without explanation. In this, as in other parts of the work, chemical reactions are left unconsidered, while mechanical details are described at length. In a treatise on Chemical Technology, the chemistry of processes should be given predominance. Bunte's burette is briefly described, and recommended for the analysis of furnace gases; but the draughtsman responsible for the illustration of the "suction bottle" to be used in connection with it, cannot have had a proper conception of its mode of operation, as he has carried the inlet-tube to the bottom of the bottle, thereby making suction almost, if not quite, impossible.

Chapter VII. is chiefly on stoking machinery, of which the Arrol-Foulis, the West, and the Ross are described with the aid of illustrations. Then we come to two-thirds of a page devoted to the inclined retort system, and an illustration of the Coventry installation. At the present day, such treatment of this system in a book of the scope and size of that now before us is absurdly inadequate. Five, or even perhaps two, years ago, so brief a reference to inclined retorts would perhaps have been excusable; but now, with hundreds coming into use all over the country—and notably in Birmingham—the author must be well aware of its insufficiency. Actually, it gives us the impression, which is confirmed in subsequent chapters, that the greater part of the book has been written at least two years, and has not been subjected to revision by the author since. The only references of later origin, which we have noticed, are the quotation, to which we have already referred, from the Board of Trade returns for 1898, and some statistics on the use of prepayment meters. But naturally figures such as these would not be filled in until the work was in the press. For the rest, there is nothing to indicate that the author's labours did not end at least two years ago. In view of the many technical advances which have come into prominence during the last two or three years, the work is clearly already out of date at the time of publication. To particularize, it has no mention of the Dellwik water-gas process, the Burnley process for the removal of naphthalene, the Botley carburation process, the Beckton or Bueb cyanogen recovery process, high-pressure incandescent gas lighting, or the method of photometry introduced in London in 1898. All these subjects ought to be discussed in a work dealing with the chemical technology of gas, published at the present time. These omissions are the more regrettable as Mr. Hunt's comments on such matters would have been highly appreciated and could not have failed to be instructive.

Chapters VIII. and IX. treat of condensers and tar-extractors in an adequate manner. Exhausters are dealt with in the following chapter quite satisfactorily. It is noteworthy that the portions of the work which deal with machinery or construction are extremely good, though the treatment at times appears to be somewhat superficial—perhaps owing to the author's conviction that engineering matters must not have undue prominence in a text-book purporting to deal primarily with the chemistry of gas lighting. But it is impossible to give a consecutive and instructive account of the chemistry of gas manufacture without introducing descriptions of the various types of plant in use; and Mr. Hunt might well have been pardoned had he strayed even more than he has done from the technological chemist's point of view of the gas industry. As it is, he describes plant in a good but superficial manner, and rarely, if ever, gives the reader the benefit of his own ripe experience of the merits of different types. Where fuller description or comment is given, as often as not the words of other gas engineers are quoted at considerable length from our columns or the proceedings of the technical associations. Compilation of this nature, however, does not require a man of Mr. Hunt's experience and ability for its adequate execution; and we confess to a sense of disappointment that in this work he has rarely risen to the level of the better-class technological authors.

Chapter XII., on washers and scrubbers, is one of the best in the book, though we doubt the wisdom of using an experimental meter for measuring *crude* gas in making estimations of ammonia at the inlet of scrubbers, notwithstanding that Mr. Hunt suggests it. On most works aspirators would be used instead of experimental meters until after the gas had been purified.

The following chapter is on ammoniacal liquor and the manufacture of sulphate, concluding with some account of the recovery of cyanogen from coal gas. But the Beckton process, by which more cyanogen products have probably been recovered from gas in this country than by any other system, is not mentioned, though it came into operation about the date of the patent taken out by Mr. Foulis for a different process, which is described by Mr. Hunt. Dr. Bueb's independent discovery of the Beckton process, or a slight modification of it, some time later, which was described in the "JOURNAL" more than twelve months ago (see Vol. LXXIV., p. 308), is, of course, also not referred to.

Chapter XIII. deals with purifiers and centre-valves quite well, and the following two chapters with purification and purifying materials. Here, and elsewhere, the author speaks of 20 grains per 100 cubic feet of gas as the maximum amount of sulphur allowed in the winter by the Gas Referees in the supply to the Metropolis; whereas we believe their winter maximum has been 22 grains from 1881-1882 to the present time. Very full details are given of the author's trials of the Claus method of purification in closed vessels. Strangely enough, the author makes no mention of Weldon Mud as a purifying agent.

Chapter XVI. gives methods for estimating various impurities in coal gas. The following chapter is on station meters and gasholders. Here Mr. Hunt is at his best, as, for the moment, he gives himself up to purely engineering work. By mischance, an illustration of the 12 million cubic feet gasholder at East Greenwich appears as a "Gasholder at Rotherhithe." Governors and pressure-changers are also well treated in the next chapter; and in Chapter XIX. distribution is tackled in a good, even if a rather superficial, manner. Here we find the comments on the effects of high heats in carbonizing, which in our opinion should be transferred to the chapter on carbonization. Chapter XX., on gas-meters, both wet and dry, is also good, and in one respect is tolerably up to date, as the number [86,000] of prepayment meters in use in June, 1899, in the South Metropolitan Company's district is given.

Chapter XXI. is one of the most comprehensive, and withal, (notwithstanding grave defects) one of the best, in the book. It deals with gas enrichment processes. In his remarks on the carburetting value of various hydrocarbons, we are disposed to think that the author was mindful of the remarks he made in our "Correspondence" columns on the series of articles on the "Enrichment of Coal Gas" which appeared in Vol. LXX. of the "JOURNAL." But inasmuch as the writer of those articles was then justified in claiming that tests of enrichment value should be made under the standard photometric conditions of that date—*i.e.*, at a fixed rate of consumption of 5 cubic feet per hour—so now should tests be made under the photometric conditions introduced by the Gas Referees in 1898, which allow of a variation of the rate of consumption to suit the quality of the gas. This change in the Referees' method of photometry unfortunately rendered the articles referred to comparatively valueless within a year of their publication; but it gave effect to Mr. Hunt's views on the testing of rich and poor gas. Why does he, in the book before us, write as though there had been no change in 1898 in the Gas Referees' method of photometry? He speaks more than once of the "gas consumed in the usual way at the Referees' standard 5 cubic feet per hour rate;" whereas the Referees actually prescribe that the rate of consumption is to be varied until a 16 candle power flame is obtained. This chapter would have been excellent in 1897; but it is now out of date, as the author must know full well. Much—probably more than it deserves—is said about the Dinsmore process. Then we have some account of oil-gas manufacture, concluding with a description of the Peebles process. Next we come to carburetted water gas. Several types of present and past plant for water-gas manufacture are described. We do not think, however, that the chemistry of the water-gas process is anywhere adequately dealt with. Moreover, no mention is made of the Dellwik system, nor of the report of the Home Office

Committee on Carburetted Water Gas, though something is said about the toxic properties of the gas. The account of enriching processes concludes with a little about acetylene.

Chapter XXI. treats of combustion, and contains descriptions of Hartley's and Junkers' calorimeters. The following chapter, which is the last in the book, deals with gas-burners. Nothing better could be desired in so far as the older classes of burners are concerned; and there are some useful comparisons of the value of Welsbach, Sunlight, and other incandescent mantles. The Kern burner is mentioned as a novelty, and values obtained with it do not appear to be included in the comparisons made with various mantles. We have not found any reference to high-pressure incandescent lighting, which has lately developed so considerably. A brief index concludes the work.

There are upwards of 300 illustrations, for the most part of plant and mechanical appliances. The few illustrations there are of chemical or analytical apparatus are, on the whole, not particularly good.

The work will, we fear, prove a disappointment to most readers. Much is expected of a man of Mr. Hunt's experience, knowledge, and ability; while this book might well have been compiled by a moderately capable mediocrity, for aught it contains of internal evidence to the contrary. But perhaps its worst fault is that it is out of date.

OBITUARY.

William Livesey.

One who was known to gas engineers of the present day only by name passed away last Tuesday, at the ripe age of 88. Mr. William Livesey (uncle of Mr. George Livesey and the late Mr. Frank Livesey) ceased his active connection with gas affairs some seven years ago, though to the very last we understand he took a lively interest in gas matters, but not from the manufacturing point of view. Mr. Livesey was for a considerable number of years connected with the firm (long since dissolved) of Messrs. Baxter, Rose, and Norton, Parliamentary Agents and Solicitors to a large number of Railway, Gas, and Water Companies. When the firm dissolved partnership, and the railway and gas and water interests were severed, Mr. Livesey remained with Messrs. Baxters and Co., as head of their parliamentary department—being eminently qualified for this position by his lifelong acquaintance with parliamentary and legal proceedings affecting the industries with which the "Journal" is identified. Mr. Livesey was a pretty constant contributor to our pages, as Secretary of the Gas and Water Companies' Association; and he never failed to enlighten readers regarding points on which any doubt existed as to their rights and responsibilities. His last letter to the "Journal" appeared on Dec. 4, 1894; his retirement from active work having taken place some twelve months before. To mark the sense of their indebtedness to Mr. Livesey's able counsel and advice, a Committee was formed, consisting of representatives of a large number of Gas and Water Companies throughout the country, with Mr. Howard C. Ward, the Deputy-Governor of the Gaslight and Coke Company, as Chairman, and Mr. Corbet Woodall as Hon. Secretary and Treasurer, to present Mr. Livesey with a testimonial; and a sum of over £700 was collected. Since his retirement, Mr. Livesey has lived in the enjoyment of good health and the possession of all his faculties, except that he suffered from chronic deafness. He was active and busy in his garden at Hammersmith up to a week before his death, which took place quite peacefully as the result of extreme old age. The funeral on Friday last was at Hammersmith Cemetery.

Mr. John Jarratt, the Town Clerk of Loughborough, died last Sunday week, at the age of 58 years. The sad event calls for notice here from the fact that Mr. Jarratt was in large measure responsible for the promotion, at different periods, of the Bills in Parliament which authorized the transfer of the gas and water works and the construction of reservoirs at Nanpantan and Blackbrook. In March last year, the Town Council paid Mr. Jarratt a handsome tribute for his work in providing the borough water supply.

Death has removed an old and respected official of the Devonport Gas Company. Mr. Richard Clark, who was Engineer and Manager of the works for 24 years, died on Sunday week. He had been unwell for a short time; but the end came suddenly, to the regret of a large circle of friends. Mr. Clark was born in London, and was Manager of the Truro Gas-Works when he was appointed to take charge of the Devonport works. Under his management the gas-works have been practically rebuilt, and the undertaking greatly developed. The funeral took place on Thursday, and was attended by the Directors, officials, and workmen of the Gas Company and many private friends of the deceased. Mr. Clark is the third official of the Company who has died within the past few months; the others being Mr. John Williams, who was Secretary for so many years, and Mr. R. C. Smith, who was Chairman for half-a-century.

The estate of the late Mr. W. Brown, J.P., the Chairman of the Chester and Hawarden Water Companies, has been valued at £65,052 gross, including personalty of the net value of £43,437.

NOTES.

Carbolic Acid Classified as a Poison.

It is sensibly argued, in the "Chemical Trade Journal," that the new season opens with several troublesome problems confronting the wholesale chemical trade. One of these is alleged to be the necessity, in the interests of manufacturers and dry-salters, for watching the "meddlesomeness" of the Pharmaceutical Society in procuring the scheduling of "carbolic acid and its homologues" as a poison. This declaration is a useful reminder that there are other dangerous (if improperly employed) commodities in extensive sale and use besides carburetted water gas and petroleum. The question is asked, Where is this scheduling to stop? Doubtless, carbolic acid and its homologues are poisons; and, not only so, but the mischief-making public have manifested a decided predilection for using them as such. A singular taste, perhaps; and, it might be argued, a very painful way of escaping from the world of the living. But it is certain that, for one fatality accidentally caused or deliberately brought about by the agency of towns' gas or lamp oil, several are yearly traceable to the careless or intentional misuse of carbolic acid. Ordinary coal-tar creosote contains much carbolic acid, and is a fluid. This might be scheduled; and so might ammonia. Perhaps when a paternal Government has successfully placed obstacles in the way of the development of the illuminating gas and mineral oil industries, it may be encouraged to devote more attention to the equally dangerous products of chemical industry actually sold freely in the market.

Fireproof Building Construction and Gas-Piping.

Considerable progress has been made of late in the matter-of-course adoption of fire-resisting construction for town buildings. The simplest and cheapest method is coke breeze concrete rammed between wooden joists, with flooring-boards nailed directly upon it, and the underside plastered for a ceiling. An improvement upon this is expanded metal in thinner concrete, lying upon steel joists—the underside of the joists being protected by another layer of expanded metal, plastered. These constructions are all very well in their way; but a difficulty arises when gas-pipes, or telephone and other electric wires, have to be fixed in buildings so constructed. The tendency of modern building design is to multiply these accessories of housing; and no general solution of the problem of inoffensive piping or wiring has ever been suggested. Some of these means of communication can be exposed conveniently; but others must be put out of sight. Sir John Taylor, the Architect of the Record Office, has challenged architects to meet this difficulty; but although the gravity of the subject is generally admitted, there does not seem to be any sign of the embodiment of any accepted rules of practice in this regard. While this uncertainty remains, errors of detail leading to possible disaster are to be dreaded. Those whose experience lies among these matters, should give the public the benefit of any success that may be proved to attach to methods of piping and wiring buildings in accordance with the conditions imposed by fireproof, or fire-resisting, construction. In view of the fact that the suppression of all hollow spaces in walls and floors, where pipes and wires have been wont to lie, is a common requirement of the sanitary reformer and the fire protectionist, this question of where to put the pipes becomes anything but a trifling problem.

The Taylor-White Tool Steel Process.

One of the novelties of mechanical science for the year is the Taylor-White tool steel process, a display of which has been made at the Paris Exhibition. The process originated at the works of the Bethlehem Steel Company, of the United States; and the first public account of it appeared in the "Engineering Record." It was devised by Mr. F. W. Taylor and Mr. Maunsel White, both Engineers in the Company's service, with the object of increasing the working capacity of the machine-shop to keep pace with that of the forge. A preliminary investigation into the reasons of this discrepancy, revealed the fact that the men in the machine-shop used a miscellaneous assortment of steels for making their tools, the working speed of which depended, in the last place, upon the character of the steel composing them. The next step was a series of experiments on special tool steels in a particular lathe, which led to the discovery of a method of treating the steel that greatly increased its cutting capacity. For the present, considerations of the patents forbid any full disclosure of the nature of the process, the effect of which is to impart to steel tools an extraordinarily serviceable degree of hardness, which they are able to retain even at a red heat. Consequently it is possible, with one of these tools, to cut steel at a speed high enough to bring the cutting edge to a bright red heat, when it still goes on cutting, and leaves an unusually smooth finish. All the tool steel now used at the Bethlehem Works is of this kind, with the immediate result that the tables are turned, and the forge has been enlarged to keep pace with the machine-shop. Ordinary hardened steel tools will not stand for five seconds a rate and depth of cut which the new process tools will keep up for twenty minutes at a stretch. One advantage claimed for the use of these tools in actual work is that when they are cutting dry at the rate of maximum efficiency, the chips come off blue, so that the foreman can tell at a glance whether the work is being done at the proper speed.

THE INTERNATIONAL GAS CONGRESS.

COAL-HANDLING MACHINERY.

By F. D. MARSHALL, of Copenhagen.

[A Paper read before the International Gas Congress at Paris.]

The mighty problem ever vexing men's minds is that concerning the relations of Capital to Labour. During the latter part of the Nineteenth Century, this problem has reached an acute stage; and the fate of great industries—yea, indeed, the welfare of nations—is resting on this great social economic question. Looking at the matter broadly, it cannot be supposed for one moment that coming generations of men will be content to toil, manually, as their forefathers have done, through successive ages. It is unreasonable to expect that, with steadily developing brain culture, men will be content to dig and delve, or to depend for an existence on mere manual labour. It is against the ethics of mental and economic progress to expect that it should be so.

Social Democracy and Trades Unionism have endeavoured to create a creed or cult to the effect that Capital is inimical to Labour, and that the advent of machinery to perform work hitherto executed manually must be to the undoing of the working population. What a wicked fallacy this is! Look at that great country America, where the use of machinery for industrial and domestic purposes has reached a stage beyond the dreams of man even fifty years ago. Has the introduction of such labour-saving machinery been to the undoing of its teeming peoples? Far from it; for the introduction of labour-saving appliances has tended to elevate the nation as a whole, and to place it in that forward position it now holds among the nations of the world. Labour-saving machinery tends to the mental elevation of the masses; it signifies the development of the brain as against the development of the muscle or brute force.

Take the coalheaver as synonymous of muscle. He must give way to the higher creation, the trained mechanic, until by natural evolution the coalheaver himself becomes trained to use his brain in preference to his muscles. The handling of great masses of coal is a pretty problem, affording a vast battlefield for the struggle between mind and matter. It is a fascinating problem. The writer has made it a special study—as, indeed, others have done—and in the great coal-producing and coal-using centres manual labour is being gradually superseded.

The contents of this paper present no very original features, as the writer has had the honour of placing his views and a description of his appliances before other technical societies at an earlier stage; but the question is of such vast interest that a repetition of some of his experience, and a dilation on the results achieved, may not be unacceptable to an international gathering of experts.

Naturally, the selection of the particular appliance for handling coal must be determined by local conditions; and an appliance admirably suited for one locality would fail in another. Take the writer's experience, for instance, and the problems he had to solve. In dealing with one particular locality, two distinct systems of discharging and storing coal have been adopted. The problem was to receive and store coal in bulk at one spot, and to transport by degrees, discharge, and re-store at another. At the Copenhagen Free Harbour, the coal required by the Frederiksberg works of the Danish Gas Company is received in bulk, and is raised from the steamer and stored by the beautiful Hunt system—mainly the invention of C. W. Hunt, of the United States.

Let me describe this installation, and the financial results achieved. We lift the coal from 2000-ton steamers by means of moveable elevators or cranes six in number, 75 feet high, and running on rails parallel with the quay. The cranes are furnished with outrigged-booms, projecting 32 feet over the water. The outrigger-boom is parabolic in shape, and so constructed that the pull of the chain from a 100-horse power steam-winch fixed in the head of the crane-tower causes the boom truck or carriage to run up the boom as soon as the steam-shovel is hoisted as high as the outer extremity.

Steam Winches.—The steam winches are each of 100-horse power, and are fitted with two flat-link steel chains of special construction. The one is the lifting chain, and the other the "dumping" or discharging chain. To lighten the load on the steam-winch, and to compensate for the 5 tons dead-weight, a counterweight wound on a conical pulley attached to the steam-winch is arranged.

Steam Shovels.—The steam shovels employed are of the very simplest description; the opening and shutting of the same being effected by the "dumping" chain being wound around a drum or wheel fixed in the axis of the two halves of the shovels. When open, the shovels gape 6 feet, lift 2 tons of coal, and the weight, together with the load and the lifting and dumping chains, is 5 tons.

*Automatic Cars and Tracks.**—These cars are of peculiar construction, and are made to discharge their load and to return to their starting-point quite automatically. The cars in question can turn a curve of 30 feet radius, can run on an uneven track, and carry a dead-load of 2 tons. Their speed of running is 300 feet in 35 seconds. After being started by a push down the incline by the hopper man, they "dump" their load at any required spot, and return quite automatically to the starting-point for a new load.

The method by which the car returns to the starting-point, after automatically discharging its load, is both novel and ingenious. When the loaded car has reached the end of its journey, it has raised a weight (W on the diagram) to a certain height by means of a wire-rope cable, which the car picks up on its journey. The details may be more fully explained as follows.

The car has fixed on the front two horns or grabs; and these, a little before the car arrives at the "tripping-block" E, where it is emptied, catch on to a sledge S attached to the cable, which passes over the pulleys A B. The ends of the cable, after passing round the moveable pulley C, are fixed at the points D D. The moveable pulley C runs on a rail fixed to a beam under the railway; and to the axle of the pulley a triangular wooden box W is attached by one corner, the opposite corner being hinged to an upright post, and the box weighted with stones.

Now the loaded car having been started, it runs at full speed until the projecting horns catch the sledge S, carrying this along until the tripping-block E is reached. By this action, the pulley C is moved in the direction of arrow No. 1; and at the same time the weight W is lifted into position, as indicated by the dotted lines. The car having dumped its load by the tripping-block loosening the wire-rope "trippers" attached to the car, has no longer any power to keep the weight W elevated; and this, in falling, causes the direction of the cable to be reversed—the pulley C returning in the direction of arrow No. 2. By this action, the sledge S gives the car a good push, powerful enough for it to overcome the resistance of the incline and to return it to its starting-place under the hopper. Wherever the tripping-block is placed on the track, there will the car unfailingly discharge its load. The weight W may be fixed at any convenient spot, and the weight of stones required can be ascertained by experiment.

Coal-Pockets.—The arrangement of coal-pockets consists of three separate buildings (one of the buildings is shown on the plan), each containing 18 pockets, or "silos." These pockets will hold, roughly, 550 tons of coal, or 10,000 tons in each building; the total quantity in the three buildings being about 30,000 tons when quite full. Over each pocket run two sets of automatic tracks, 36 in all. Eighteen of these tracks are continued through the buildings to the large covered space beyond. This space is calculated to store another 50,000 tons, making the total storage 80,000 tons. The designing of the pockets was the occasion of much earnest consideration; there being a choice between iron, wood, and composite structures.

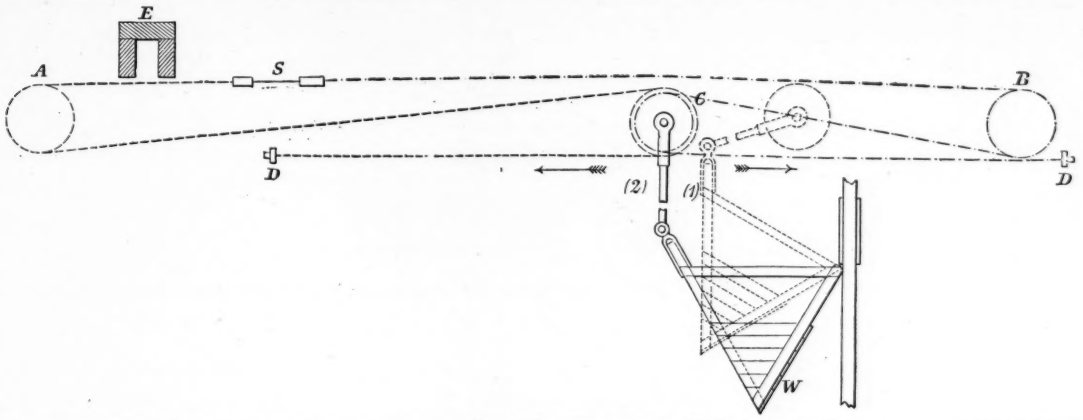
Iron is objectionable, on account of expansion and contraction in the event of the coal becoming heated; while a wholly wooden structure (as adopted in America) is unsightly. The surroundings in the Free Harbour possess a large degree of architectural merit; and as it was necessary that the pocket buildings should follow the style, it was determined to construct the outer walls of Monier cement work, resting on brick and granite foundations, and the internal division-walls of timber. The outer Monier walls are made 11 cm. thick; the wire-work netting embedded in the cement consisting of tension-rods 12 mm. thick, kept apart by distance-rods 5 mm. thick, interlaced in the manner of basket work. The walls are calculated to stand a lateral thrust of 461 kilos. per square metre at the top, 800 kilos. per square metre in the middle, and 1077 kilos. per square metre at the bottom. When the pockets are quite full, and although they may perhaps bulge under this great strain, there is no fear of their giving way. The walls are tapered; being thicker at bottom than top. The bottoms of the walls are anchored in the pediment of brickwork in cement. The walls are strengthened vertically and laterally by I-irons, and by wall-plates through which ¾-inch bolts are passed, bolting the whole of the outside shell to the framework of strong wooden beams forming the interior. These beams likewise support the divisions of the pockets.

The bottoms, or floors, of the pockets consist of series of Monier arches, 10 ft. 6 in. span by 2 ft. 6 in. rise, springing from channel-irons resting on concrete piers. The arches at the crown are only 5½ inches thick, and are calculated to stand a strain of ¾ ton per square foot. The Monier network of the arches consists of tension-rods, 8 mm. thick, and spacing rods 5 mm. thick. To prevent the arches flattening out, a series of tie-rods, 1¾ inches diameter, spaced 14 inches centre to centre, are employed; the ends screwed and bolted to the channel-irons previously mentioned.

Now the question naturally arises: Does this installation pay? The cost was some £55,000; and assuming the six cranes to be at work, 300 tons per hour can be discharged—3000 tons per working day. The cost of discharging has been found by experience to be not higher than 2d. per ton, from the time the coal is raised from the ship's hold until it is deposited in the store-pockets or "bins." The installation has now been working for three years with the most satisfactory results.

From these large stores, the coal required for the gas-works at Frederiksberg is sent daily by rail, in 10-ton trucks. These

* For the sake of making clear Mr. Marshall's description, his diagram showing the working of the automatic cars and tracks is reproduced. The other diagrams exhibited by Mr. Marshall at Paris during the reading of his paper were similar to those published in the "JOURNAL" to accompany his various papers read before the Institution of Gas Engineers—see "JOURNAL," Vol. LXV., pp. 1248-9; Vol. LXIX, p. 1121; and Vol. LXXI., p. 1452-3



trucks are of peculiar shape, and open at the bottom. On arrival at the gas-works, the 10 tons are dumped at once into a hopper, and in less than ten minutes are elevated and, by a band conveyor, deposited in the overhead stores or bins. From the bins or stores, the coal is transferred by a lower conveyor band to the elevators supplying the hoppers for the inclined retorts in the retort-house.

This installation—the invention of the writer—may thus be described: 120 tons of coal are handled by the aid of two men—that is to say, the coals are received, crushed, and stored at the rate of a ton a minute, and can be simultaneously removed from the store and conveyed to the retort-house at a similar rate. The train conveying the coal to the works consists generally of ten to fourteen waggons, containing 100 to 140 tons; and this quantity of coal, allowing time for shifting trucks, can be stored by two men in from three to three-and-a-half hours.

The coal pockets or bins are like four-sided inverted pyramids. The sides, however, are not flat, but each formed of an arch. The lower ends of the pockets are fitted with emptying regulators, worked by ratchet and pinion wheels; so that by only adjusting the speed of their revolution, a larger or smaller quantity of coal may be ground out—no coal being able to pass until the regulators are in motion. From the regulators, the coal drops on to the lower cotton band conveyor, which carries the coal to the hoppers of the elevators, which, in their turn, elevate it to the overhead tanks in the retort-house, destined to feed the inclined retorts with which the house is fitted. The lower conveyor bands being in gear with the regulators, the speed of emptying and conveying is nicely adjusted. The coal-store, with pockets all filled, will contain 1000 tons, or about a week's supply for the house as at present erected—about 1,250,000 cubic feet per diem maximum.

All the machinery is worked from the engine-room; and one man can receive and empty waggons, and fill the overhead coal-tanks in the retort-house, at the rate of 120 tons per day. The machinery and coal-store will cost £3500; but considering the enormous saving in labour, there can be no question that the outlay will be speedily recouped.

Such is the general design of the store at present erected; but the special point with which this paper is connected is the construction of the coal bins or pockets. The weight of coal to be supported amounts to 3 tons per square foot; and to support this weight in the air in an economical and practical manner, presented many difficulties. Of course, the pockets could have rested on the ground, and a small tunnel have been excavated underneath for the conveyor bands and machinery. But it was necessary that the openings of the pockets and regulators should be easily accessible; and it was deemed requisite to raise the bottom of the pockets above the ground. This involved very careful consideration, when the great weight of the superincumbent coal is taken into account. Brickwork and wooden framings were all duly considered, and abandoned on account of cost and cumbersomeness. Resource was at last had to the Monier principle as a solution of the difficulty. The Monier arches composing the bottoms of the pockets spring from the ordinary concrete arch foundations, as they are only subject to compressive strain, whereas the pockets themselves are subjected to enormous tensile strain. The arches underneath the pockets form an excellent subway; and all parts of the machinery, bands, and regulators are easy of access. The section of the Monier arches involved much calculation, as the pressure of the coal pyramids is very curiously and unequally distributed. No material, however, has been wasted in their construction.

Referring to the matter of prime cost, the question will be asked, Can such an installation really pay? Here are figures, based on the fact of the installation having cost complete £3500, and been destined to handle 30,000 tons of coal annually.

One man, storing, three hours daily, supplying hoppers in retort-house and clearing up, looking to engine, &c., three hours daily, at 3½d. per hour, say, annually	£33
Two men shifting trucks, three hours each, at 3½d. . . .	33
Oil, waste, brooms, annually	30
2 per cent. depreciation on £3500.	70
4 per cent. interest on ditto	140
Total	£306

On an annual quantity of 30,000 tons = 2·44d. per ton, for unloading, storing, supplying the retort-house, and including wear and tear and interest on capital.

The two installations described are eminently successful, and have not failed for a single hour since started some years ago. The wear and tear is inappreciable; and the question of labour (sorrowful as it is to say so) is reduced to a vanishing point.

Before concluding this paper, the writer wishes to bear testimony to, and express his admiration for, the work of others in the same direction. Herr Possehl's "Kolenhof," at Hamburg, is a splendid installation, designed principally for handling nut coals. The elevating machinery is of the corn-elevator type, and the pockets or bins are supplied by quick-running conveyor bands similar to those designed by the writer for the Frederiksberg works. The pockets or storage bins are beautifully constructed of Monier work. The whole installation is driven by electricity, and is perfect in every respect. Messrs. Graham, Morton, and Co., of Leeds, have also erected several excellent installations for the transport and storage of coal, principally for collieries; while in America much has been done in this direction. The writer has unfortunately no knowledge of what is being done in France.

Beyond the pioneer installation described, the writer is unaware that automatic coal-stores have been erected at any other works than those at the new Stadt Gas-Works at Zürich, by Herr Weiss; and the design of these stores closely follows those of the writer. The coals are lifted and stored by the automatic railway just described. The difference between the writer's and Herr Weiss's emptying arrangement is the form of the emptying conveyor, which, in Herr Weiss's case, is of the grasshopper or shuttle description, while the bottom of the stores containing the emptying machinery is excavated, instead of being constructed overhead as in the case of the writer's. It would be of extreme interest to hear from Herr Weiss an account of the working of the Zürich apparatus, more especially the results achieved by the shuttle conveyor.

SEPARATE GAS-PRODUCERS FOR THE HEATING OF RETORT-BENCHES.

By G. Eichelbrenner.

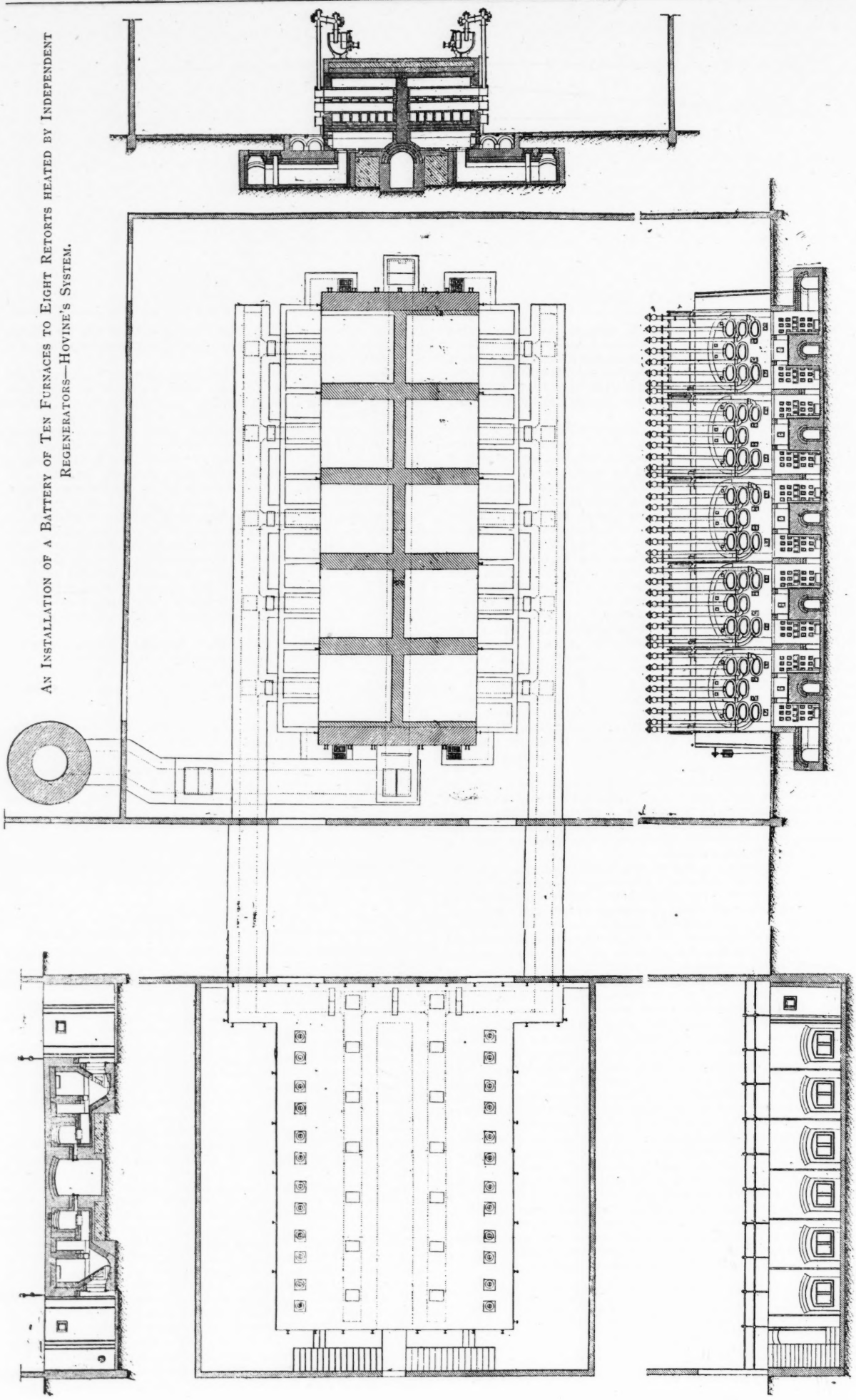
[A Paper read before the International Gas Congress at Paris.]

The installation which I here describe presents some notable differences from those commonly in use. These departures are due to certain special causes; yet I believe that applications of this system can frequently be found. It fell to my lot to completely reinstate a works established near some coal mines on ground which, in consequence of the subterranean operations, was continually undergoing subsidence. Although a foundation of concrete was very thoroughly laid, a completely stable sub-soil could not be guaranteed. One therefore foresaw trouble from the settling of the furnace masonry, and it was of the greatest importance to reduce the results of these irregular subsidences of the ground as much as possible.

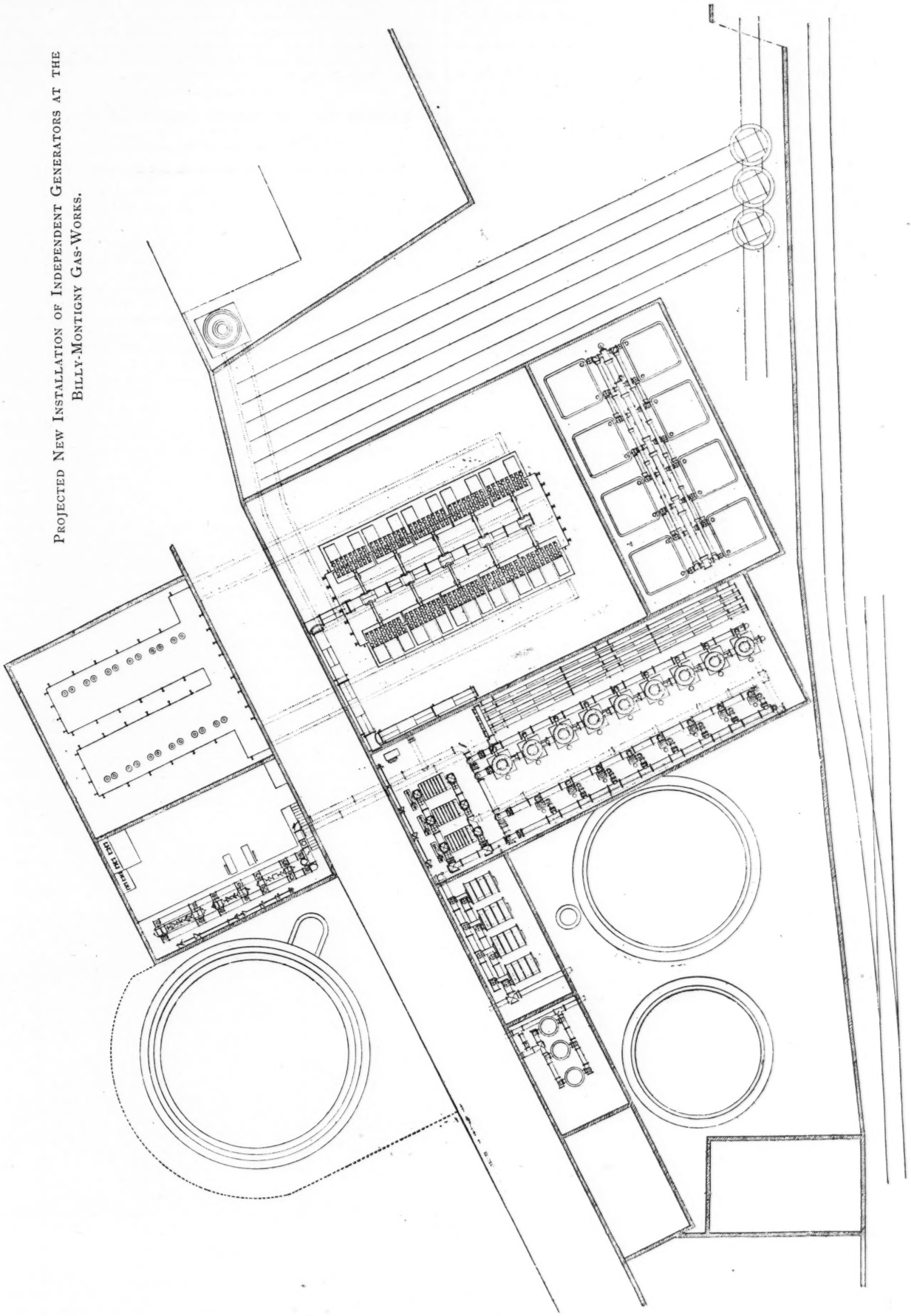
This I sought to do by separating the gas-producers from the recuperators. The producers are very solid, and scarcely liable to damage. The furnaces and recuperators, on the other hand, can easily be put out of working order by portions of three-cuperators or the retorts getting out of place. But, it ought to be added, the repair of such accidental damage can be done easily and quickly when it does not involve also repairs to worn-out portions of the furnaces or gas-producers. Having a sufficient number of spare furnaces, it is enough, in the case of a damaged furnace, to shut off the gas from this furnace, to supply it to another, and, after examining the damaged furnace and closing up any fissures, to put it to work again.

It will be admitted at once that it is the almost general custom, when regenerative furnaces are being used for the distillation of coal, to place the producers close to the retort-benches—generally below, or at any rate in front of, the furnace, in the sub-soil, and at some very short distance from the main installation. The aim of the constructor is to arrange furnace, producer, and recuperators in the smallest possible space, with the object of

AN INSTALLATION OF A BATTERY OF TEN FURNACES TO EIGHT RETORTS HEATED BY INDEPENDENT REGENERATORS—HOVINE'S SYSTEM.



PROJECTED NEW INSTALLATION OF INDEPENDENT GENERATORS AT THE BILLY-MONTIGNY GAS-WORKS.



avoiding loss of heat, which may be very considerable if the surfaces of the apparatus are exposed to the air. Nevertheless, many of the furnaces used for regenerative heating in glass making, metallurgy, &c., have the producers quite separate from the heating-chambers. A pipe distributes the gas (from the battery of producers) among the different furnaces, which have near to them only the recuperative plants.

This system, which I have adopted in connection with coal-gas distillation, presents several points of advantage, which are not to be despised: (1) It dispenses entirely with the room required for stoking the furnaces, leaving the space around the retorts free for the operations necessary to this stage of the process. (2) It allows the feeding of the producers to be done in the open air. High temperature, dust, carbonic oxide, and steam are thus avoided in the retort-house, which cannot be completely free when the furnaces are charged there. (3) It permits the use of fuels of lower quality—such as lignite, peat, and waste material from shale—the combustion of which requires a furnace area for which space could not be found within the limits of the furnaces. Besides, to bring such special fuels into the retort-house would prove a serious inconvenience. This use of inferior kinds of fuel, considered alongside the advances in price of coal and coke, is an important advantage. (4) The furnace, and the producer which supplies it, are rendered quite independent of each other. Owing to the way in which the yield of gas from a producer can be increased, and to the comparatively slight wear and tear of the apparatus when fed with coke, there need not be so many producers as there are furnaces to heat. Six or eight producers will supply eight to ten furnaces. (5) Lastly (and this is a point of which advantage has been taken in many works), heating by producer gas can be done, even when there is water at a short distance below the surface; for the producers can be used at such a distance as not to be touched by the water, whereas if placed underneath the furnace they might be flooded.

Two objections may be urged against this system: (1) Less economy in fuel, owing to the loss of heat in transit. (2) Greater cost of plant. We will take these two points in turn.

(1) This objection falls to the ground where the arrangement of the producers in batteries permits the employment of cheap fuels—such as peats, lignites, &c. The economy in weight may be *nil* or negative; but the economy in money is a fact. Then, if the distance to be traversed by the gas is considerable, and it reaches the furnace cooled, it is easy to re-heat it, without any further cost, in a recuperator connected with the recuperator of the secondary air. Supposing that the gas reaches the furnace at 250°, instead of 500° (the temperature at which it leaves the producer). There will be a loss of heat, it is true; but compensation exists in the fact that the waste gases from the furnace are cooled to 250°, whereas if they were used to heat only the secondary air, the temperature on exit would be 500°. If the intervening distance is less, or if the pipe is well insulated, the loss is very slight. It is known that the gasification of coke into carbonic oxide absorbs 23 per cent. of the heat which is needed to raise the temperature of the gaseous product to 850°.* If the gas is cooled instead of at once passing to the furnace, there is a loss. Suppose the cooling reduces the temperature to 200°, the loss is—

$$0{\cdot}23 \times \frac{200}{850} = 5{\cdot}5 \text{ per cent.}$$

of the total heat. But, as Ebelmen has shown, the proportion of the total heat used in a high-temperature furnace is very small (4 to 35 per cent.); and hence we come to the conclusion that the loss resulting from the cooling of the gas is of little importance. Yet, as it is a real diminution of the heat realized, it is well to insulate the gas-main as thoroughly as possible. In the case above referred to, I laid the pipe in the sub-soil surrounded by refractory earth, and kept it dry. Irregular subsidences of the soil may allow these pipes to sink; but they will not on this account give rise to appreciable leakage, and the escape is very easily put right. It is possible, of course, to make the walls of the producer and the protective coating of the main of such thickness as to prevent loss of heat from the parts above ground. In collecting information on installations of this kind already in use in gas-works, I find that the cost per 100 kilos. of coal distilled does not appreciably differ from that when the furnace is placed underneath—a fact confirming the theoretical considerations advanced above.

(2) The construction of this battery, made in the north of France, and during a period of high prices in materials, works out to 1·435 frs. per retort for the installation shown, in which a producer for every furnace has been provided, in view of possible accidents from subsidence. Under normal conditions, eight producers would be sufficient; and the cost per retort would be 1·355 frs.

A similar battery, but with producers underneath the furnaces, would cost, under the same local conditions, 1·250 frs. per retort. The difference in the original cost is thus from 100 to 110 frs. per retort, or 8000 to 9000 frs. on the total cost, which is about 8 per cent. more. Recollecting that this plant can burn coal as well as the coke for which it was designed (which cannot be done with sub-furnace gas producers), I am inclined to believe that the advantages of the system are distinctly practical, and that the method can be successfully applied in numerous other cases.

* See Lencauchez, "*Traité des Combustibles*," pp. 225 *et seq.*

In these experiments, I have collaborated with M. Hovine, an expert in matters of this kind; and I am sure that we shall obtain excellent results in the regular use of the furnaces, an account of which I shall be happy to give next year. All my condensing and purifying plant is arranged in series; and I can therefore make use of those necessary at a given moment. I shall have others put up as the make increases, without altering the buildings, plant, or mains already existent.

RESULTS WITH PREPAYMENT METERS IN HOLLAND.

By P. Bolsius, of Bois-le-Duc.

[A Paper read before the International Gas Congress at Paris.]

Gas lighting took its rise from the discovery of Jean Pierre Minckelers, a professor in the University of Louvain, who, in 1784, was engaged in experiments on the production of a light and cheap gas which could be used for the inflation of balloons, and who found that the distillation of coal in a closed vessel yielded a new kind of "inflammable air," which he afterwards applied to lighting purposes. In the latter years of the Eighteenth Century, the labours of Lebon and Murdoch gave birth to the new industry; and these three names must be given the places of honour in one of the greatest achievements of modern times. Since their day, the gas industry has made many advances, technically and commercially; and among the notable chapters in its history, must be mentioned the considerable lowering of prices which took place about twenty years ago. At that time, gas in Holland cost on the average 12 cents (about 2½d.) per cubic metre, with special rates to factories, barracks, and other large consumers. Now the price is about half the above figure. The average in Holland is 6 to 7 cents per cubic metre; while in certain towns the price is still lower. In Kampen, for example, gas for lighting is 5 cents per cubic metre; and gas for heating or motive power 3·5 cents. The startling results of lower prices are well known; and many a gas manager who is not yet grey haired has seen his output multiplied five times and more.

Among the various systems according to which gas is sold—such as reduced rates for large consumers, for gas burnt in the daytime, and for gas for heating and motive power—the prepayment plan is the latest; and some particulars of the results attending its adoption may not be without interest. There are about 100 gas-works, large and small, in Holland, 43 of which have adopted prepayment meters since their introduction some five years ago. The number of people in towns and villages, according to the latest returns, served by gas companies is 2,337,149, out of a total population (1897) of 5,074,632. The total make of these works last year was 173,675,493 cubic metres, which implies a consumption of 655,000,000 kilos. of coal. This figure possesses some interest in the calculations and statistics relating to the high price of fuels which I will discuss later. The population of the 43 towns where the meters are in use is 1,950,829; that of the remainder, who do not adopt the prepayment system, only 386,320.

Utrecht was the first town in Holland to adopt prepayment meters; and the innovation must be credited to Heer van der Horst, who has since taken charge of the Amsterdam Gas-Works. He has stated in "Het Gas" that he commenced the new system in 1895, with the greatest caution. For two months new meters made by the Compagnie pour la Fabrication des Compteurs et autres Appareils, of Paris and Dordrecht,

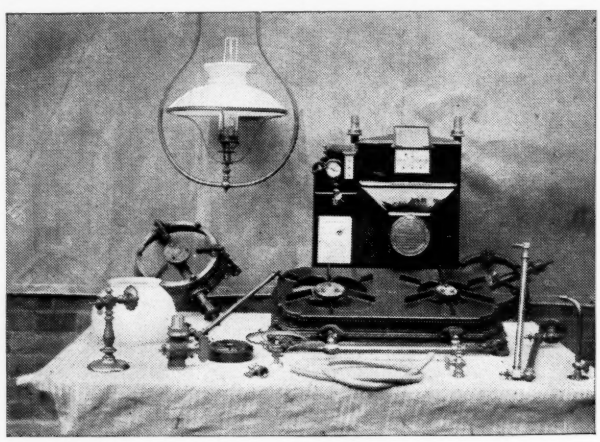


Fig. 1.

were under trial, and improvements were made, especially in dry meters. Lamps and stoves (see fig. 1) were chosen at the same time, so that when the introduction took place the meters, &c., could be properly fitted by a staff commensurate with the demand. The number of consumers has since undergone a remarkable increase. In addition to 7746 ordinary gas-meters, Utrecht possessed on Dec. 31 last, 5773 prepayment meters.

At Rotterdam, there are 8086 prepayment and 13,840 ordinary meters; and many other towns—such as Arnhem, Tilbourg, Leiden, and Hilversum—show equally favourable figures.

In Amsterdam, where at first the introduction of the meters was restricted by the excise regulations, the system has gained great popularity. On Aug. 10, 1898, when the gas-works were disposed of by the Imperial Continental Gas Association, there were 915 prepayment meters. At the end of the year there were 934; and during the following year the total rose to 1869 The promptness displayed in keeping pace with this demand will be understood when it is stated that at the present time 100 meters per week are being fixed.

Heer Geerling, Assistant Engineer at the Amsterdam works, sends me some detailed particulars, which will be of interest, as will also the photograph here reproduced. Fig. 2 shows the inspection of the staff of foremen held every Saturday about 3 p.m., at the Linnaeusstraat works. At this time, all tools are shown on their respective handcarts, for checking the contents of each against the total plant used by the foremen. Storage room being limited (in comparison with the quantities of material to be stored), only that which can be packed with the maximum of compactness is kept here. Three stations serve for the delivery of the materials to the foremen; the quantity being noted at the time. Each station is allotted to a gang of six foremen, who come up in turn. Much loss of time occurred at first in this distribution of apparatus. The different requirements, particulars of which had been sent in by the foremen the previous evening in writing, had to be collected the same night in large baskets, and in the morning had to be re-handled when applied for by the foremen, in order that the latter might check what they received.

For some time this system has been stopped; and an arrangement is now in vogue whereby the different pieces of apparatus are arranged in wooden trays, so that the requisition forms can be checked in a few seconds. A special receptacle is reserved for "lyres," branches, globes, burners, &c. A similar plan is followed in connection with the iron pipes, which are measured off in the evening, so that every morning the foremen get the quantities which they requested the preceding evening, with a note of the amount supplied. This latter is checked by a workman who signs a receipt in the storekeeper's book.

A similar time-saving arrangement is adopted for the distribution of tar, fir-wood gutters in which pipes are laid, coke, &c., which are arranged in systematic order during the evening. The watchman notes the numbers of the workmen and the times at which they leave the factory. His register goes afterwards to the chief inspector, who explains any delay, and passes it on to the engineer's office. Up to the present, prepayment meters are fitted only from the Linnaeusstraat works; but the Haarlemmerweg factory will very shortly be in a position to deal with them.

Fig. 2.

On Oct. 16, 1899, the staff comprised only two men and a handcart. Now 46 workmen and 23 handcarts are in use; and this staff will soon be greatly increased, for the requests for meters already reach 6000, and seem likely to keep coming in up to a possible total of 30,000. In May about 65 installations were made per week (about 100 are now being done per week). This, considering the staff, is not a large number; but several causes have combined to keep down more rapid progress.

First, the foremen are drawn from all ranks, and are not all acquainted with the craft. Others are weak in clerical work, and lose much time in getting out reports on material used and hours worked. Others, again, have not been used to working exclusively with drawn iron pipes. There are also the making of trenches up to 75 cm. in diameter, laying on of service-pipes, putting in the gutters for the protection of the pipes, fitting the vertical supply-pipe which passes through the various storeys, trial of connections, &c.—to all of which the new hands have to become accustomed. Then the time for the work is comparatively short. There are only five days available per week; and much time is unavoidably spent in going about.

Another difficulty is the character of the premises in which the meters are to be fixed. The dwellings of those who desire them fitted are mostly too slight to stand a supply-pipe fitting; and some amusing incidents have occurred in which parties have claimed damages for injury to their premises or property. A still further difficulty is the habits of the residents themselves, who, in many quarters, are distinguished by their conspicuous disregard of the eighth commandment, insomuch that the workman must never let his tools out of his sight, or he will never see them again.

Reverting to the difficulty of obtaining a suitable staff for the work, it is anticipated that foremen may be recruited from the students of the special schools for workmen, and that the assistance of the professors in this direction will soon enable the Company to meet the extraordinary demand. The annual consumption in prepayment meters is as follows: Maximum, 640 cubic metres; minimum, 190 cubic metres; average, 400 cubic metres.

We now come to the most important points in connection with

the prepayment system—viz., the rates and conditions in regard to which the gas is supplied. Although the mains and apparatus, fittings, and stoves used by the consumers are approximately of the same value and number in the various towns where the system prevails, opinions differ on the question of depreciation which the capital invested in the installation and working of the new system demands. Different tariffs have resulted from a degree of caution on the one hand, and a certain optimism on the other. The surcharge varies from 1½ cents to zero, compared with the usual price. In some instances, even, a lower price is charged.

In the information placed before me by my colleagues, I notice that some of them are of opinion that the prepayment system—considered from a financial point of view—can be adopted and worked with gas at such a figure that, after subtracting the expenses of depreciation and interest on the capital in mains, meters, &c., as well as extra expenses, a certain profit on the cost price of the gas is obtained. Now, I have never been able to agree to these propositions; and I hold to the conviction that it is the surcharge on the usual price of the gas which, for the most part at any rate, ought to cover both depreciation and extraordinary expenses.

The Chairman of the South Metropolitan Gas Company, of London (Mr. George Livesey), who has kindly given me his opinion on this subject, looks for the recovery of the expenses mentioned above in the surcharge on the gas. I need not speak of the authority with which Mr. Livesey's utterances on this question are associated. The prepayment system has found favour with him; and the great Company which he directs possess as many consumers by the one system as by the other—say, 100,000 for each. To obtain 100,000 consumers required

Fig. 3.

28 years; the prepayment consumers have become customers within the past eight years. He adds that no injustice should be done to the older *clientèle*, and all should be treated alike.

In London, a prepayment outfit costs 74·35 fl. (equal to, say, £6 3s.), and demands, according to Mr. Livesey, a depreciation fund of 10 per cent. for interest, working, &c. The extra expenses of inspection, administration, &c., are placed at 1·60 fl. (2s. 8d.) per annum. The average consumption in London being 510 cubic metres per annum, the surcharge should be 1·77 cents per cubic metre. The extra charge made, however, is 9d. per 1000 cubic feet—say, 1·59 cent per cubic metre.

General expenditure and cost of installations are, on the whole, greater in London than in provincial towns, where they vary from 40 fl. to 70 fl.; but it is wise in any case not to rest satisfied with depreciations of 3½ per cent., &c., in which the expenses of working, removal, and constant changing, which are unavoidable in dealing with the floating population using prepayment meters, are not included.

It would be unfair to leave unemphasized the great influence of prepayment meters on the consumption of gas in general. All my colleagues in Holland agree that no better incentive to the consumption of gas—especially for cooking—can be found. For this reason, the surcharge should not be made too high. On the other hand, however, in consideration of the wide field open to the new system, and the amount of capital sunk in it, it is unwise to fix too small an excess. To levy no additional charge, or even to charge less—as is done in some instances already cited—is an action which discredits itself. No commercial or municipal association can play a philanthropic rôle.

The surcharge should therefore be from 1 to 1½ cents per cubic metre. Almelo, with an extra charge of 1½ cents, has an average consumption which differs only very slightly from that of Hilversum, where there is no excess. The great virtue of the system is in the readiness with which apparatus and mains are placed at the disposal of those of modest means, and in the mode of payment. From this point of view, the price of the gas is a secondary consideration.

I have already said that the system requires more extensive organization in the matter of receipts; and I ought to add that administration is more cumbrous than with the ordinary meters. Fig. 3 shows the method adopted at Utrecht to simplify the manipulation of the numbers of 2½ cent pieces received. The money is counted by means of a kind of draught-board holding 100 pieces. This plan reduces labour, and is very exact. The coins are packed in paper, and sent to the banks for conversion into silver or notes.

My colleague, Heer Liefde, of Hoorn, has acquainted me with a device for protecting the meter when it is installed in the houses of (say) workmen where the walls are far from solid. It is a kind of wooden box, open at the two sides, and provided with a vertical partition in the plane of the wall. This box, being fixed at the desired height in the separating wall of two houses, permits of two meters being placed in it.

The general conclusion is that the results in Holland have fully confirmed the statements of prepayment meter promoters. Conducted wisely and liberally, and with attention to the lessons of experience, the system draws a new circle of customers, and gives a fresh source of profit; while the workman and the lower-class *bourgeois* can obtain good and cheap light and fuel always ready to his hand, and contributing to the comfort of his home.

I must, in conclusion, thank my Dutch friends for the many ways in which they have assisted me to prepare this paper—in particular, Heer Van der Horst, Dr. Neurdenburg, Heer Geerling, and Heer Van de Waereld.

FUEL FOR GAS-MOTORS.

By Aimé Witz, of Lille.

[A Paper read before the International Gas Congress at Paris.]

Among the advantages of gas-motors, is the fact that they can be fed with the most diverse of gaseous fuels, from rich combustibles like acetylene to gases as poor in calorific power as blast-furnace gas. In order to burn these different substances, the proportion of gas and air must be adjusted, a perfect mixture of the two obtained, and the degree of compression and mode of firing properly arranged. With a suitable carburetter, even liquid hydrocarbons of very different density and volatility—from petroleum ethers or gasolines to petroleum burning oils—can be used.

To this great adaptability of the motor is due the fact of its use, in town and country, in the vicinity of a coal-gas works, or other gas-making plant, either as a stationary engine or for automobile purposes, and in sizes the capacity of which vary from a few kilogram-metres to 1000-horse power. The 1000-horse power motor is to-day a practical realization of the dreams of inventors; for it is possible to connect, in series or otherwise, two cylinders similar to that of the motor shown in the Belgian Section by the John Cockerill Company of Seraing.

This machine is on the Delamare-Cockerill system of mono-cylindric type. Its cylinder measures 1·300 metres in diameter; and its stroke is 1·400 metres. Before a commission of expert engineers, it has proved itself equal to producing from 560 to 670 horse power when burning blast-furnace gas of 985 calories per cubic metre. It absorbs about 2120 cubic metres per hour to give 670-horse power. According to the original statement of a famous inventor, smelting is really a secondary operation of a blast-furnace, which may be regarded as a gigantic gas-producer yielding 150 tons of pig-iron on the one hand, and 600,000 cubic metres of gas on the other. Reckoning half this gas for heating the blast and for other purposes, there remains a surplus of gas, from a blast-furnace of 150 tons, sufficient to produce 3500-horse power in gas motors. One thousand horse power, and sometimes not so much, is obtained with difficulty when the gases are used to raise steam.

The gas-motor has thus taken up its place as an adjunct to the blast-furnace, and produces the most satisfactory results. Similar success awaits the engineers who shall use it with gas from coke-furnaces. The producers of Dowson, Gardie, Lencauchez, Deutz, Pierson, Fichet and Heurtey, Bénier, and others, have paved the way for the future success of the gas-motor.

In the earlier period of producer-gas making, it was necessary to use special coals, preferably anthracite, freed from powder, non-caking, with little ash, and yielding no fusible clinker—in short a coal of such special character that only a high price could procure. But now it has gradually become possible to use ordinary anthracite coals of moderate price, so that the cost of the producer-gas has been greatly diminished, and the possibilities of the producers greatly increased. Electric power works, pumping-stations, printing presses, looms, and spinning and other mills have taken their motive power from it with most satisfactory results. A 100-horse power motor, working 3000 hours per annum, fed with anthracite coal costing 25 frs. per tonne, furnishes 1 horse-power-hour for at any rate 4 c.,*

* I reckon 5 per cent. for interest, 3 per cent. for depreciation of buildings, and 6 per cent. for that of machines and materials.

an advantage of about ½ c. over a good steam-engine in which coal at 20 frs. is burnt. Its first cost is much less. The producer-gas varies from 1200 to 1600 calories per cubic metre. Gas producers are very suitable for coke; but the present high price of this fuel is not likely to encourage its use.

A producer has recently been put down in Messrs. Brunner, Mond, and Co.'s chemical works at Northwich, in which small and bituminous coal can be consumed; and the recovery of the bye-products has proved most satisfactory. The complete apparatus is really a miniature gas-works; but the cost of the kilowatt-hour is placed at about 4 c. (excluding interest and depreciation of plant), with Crossley motors of 25-horse power, a figure which justifies the expense of a complete plant.

The Riché producer, using wood, gives a comparatively rich gas of 3000 calories, which has been found to work well in Charon motors. It is an apparatus susceptible of many different uses in districts where wood for fuel can be found, and for this reason ought to extend the usefulness of the gas-motor.

The water gas of Tessie du Motay has not been much used as a fuel for gas-motors. The facts that the plant must have coke, and that it acts intermittently, are, no doubt, the explanation. The Dellwik producers, which give a gas of 2000 calories, have had a measure of success in Germany; while the tendency in America is to revert to the Lowe producer, as modified by Merrifield. Few experiments on the feeding of motors with water gas have been made; yet it has been shown that the engines behave as well with water gases as with mixtures of the latter and Siemens gas, whatever may be the proportion of nitrogen.

MM. Biedermann and Harvey have suggested the supply of carbon dioxide to gas-producers. The gas (CO_2) would be reduced to carbon monoxide by contact with the incandescent coke. Should this idea become practicable, it would be possible to regenerate the waste gas of the motor, and so complete the cycle of changes involved in the use of producer or water gas as fuel. The high temperature of the escaping gas would doubtless be enough to maintain the reaction; and the heat of the waste gases would thus be recovered. Unfortunately, the nitrogen would accumulate in the recovered gas (due to the air supplied to the motor); and the whole volume of waste gas could not therefore be operated upon. The outline of this process, which has been mentioned in the third volume of "Traité des Moteurs à Gaz," suggests experiments which would be perhaps more interesting than practically useful, but which would nevertheless bear upon the theory of the question.

In regard to gases obtained by destructive distillation, their calorific power varies from 3500 for gas from dried wood, to 5350 for coal gas and 7500 for cannel gas. These are average figures; but I have found coal gas—the so-called house gas—to vary from 5000 to 6000 calories.* Ordinary house gas was that first supplied to motors, for which they were designed and made, from the machines of Philippe Lebon to those of Lenoir and Otto.

With gases at 10, 15, 20, and 25 c. and motors of 4, 10, or 30 horse power, the cost per horse power per hour can be found from the following table:—

Horse Power of Motors.	Cost per Horse-Power per Hour, with Gas Costing			
	10 centimes.	15 centimes.	20 centimes.	25 centimes.
4	11 centimes	14 centimes	17 centimes	20 centimes
10	9·7 ,,	12·7 ,,	15·7 ,,	18·7 ,,
30	8·5 ,,	11·5 ,,	14·5 ,,	17·5 ,,

These figures—which are not advanced as exact, since the factors are variable—show, at any rate, that up to 10-horse power the gas-motor has nothing to fear from any other motive power, even with gas at 20 c.; while for 30-horse power the price of the gas ought not to exceed 15 c.

It is true that the gas-motor on the town main possesses advantages which would obtain support for it, even if the cost per unit of energy were greater. These are briefly: No other plant, no furnace or fireman, no stock of fuel, put in or out of action at once, and no expense when not actually in use. Moreover, it can be placed practically anywhere; and, if properly constructed, it is so nearly noiseless as not to raise objection from neighbours. The last point has not always been realized; but this has more often been due to the fixing of the motor and its accessories than to the machine itself.

In towns, the applications of gas-motors have not developed to the extent which might reasonably have been anticipated from the improvements of the past ten years. Now that 1-horse power per hour can be obtained by the consumption of 500 litres of gas of 5350 calories per cubic metre at 0°C. and 760 mm., the use of such motors ought to be profitable and economical in many industries. It is astonishing to find that the Paris Gas Company sold only 10,013,000 cubic metres of gas in 1899 for use in motors in Paris and the suburbs. This is scarcely 1·33rd of the total make—say, about 3 per cent. In Germany, certain works supply 17 per cent. of their gas for motors, although the price of gas is not less than here, nor the motors superior. It may, therefore, be hoped that the progress in this direction which has been evident in Paris in the present year, owing to the Exhibition, will continue, and that there will be an increasing demand for gas for use in motors.

The enrichment of house gas by carburetting has been tried; but it seems as though this is of no advantage to the consumer who uses the gas as a motive power. Acetylene gas, of which premature hopes were entertained, has not given any very encouraging results, in spite of the able work of MM. Ravel, Cuinat, Franck, and many others. I am not aware of a single application in this direction. All that has been done has been to show that the gas-motor can work with such a rich gas; but it still remains to make it practical.

Experimental results confirming the preceding statement are in favour of the gas-motor which, as has been mentioned, can be fed with blast-furnace gas of 900 calories, or with acetylene of 14,000 calories per cubic metre. M. Lencauchez has also shown (in the analysis of a number of more or less official reports) that the thermal yield of motors varies appreciably with the richness of the gaseous fuel. The trials I have made at Seraing and Differdange confirm this statement, inasmuch as the horse power per hour could be obtained with 3 metres of gas of 980 calories, equivalent to 549 litres of gas of 5350 calories. This number corresponds to a yield in actual work of 21·7 per cent., and in indicated work of 25·5 per cent. But I have never obtained more than 21·1 and 26 per cent.

* This relates to the calorific power at constant volume (steam condensed), as determined by means of my eudiometric bomb. I obtain complete combustion, which is not always the case with poor gases in calorimeters which burn the gas at constant pressure.

THE REDUCTION OF THE COST OF DISTRIBUTION BY THE USE OF HIGH PRESSURES.

By Frederick H. Shelton, of Philadelphia.

[A Paper read before the International Gas Congress in Paris.]

For many years gas engineers have been steadily reducing both the operating and the investment costs necessary in the manufacturing department of the gas business. The increased yield and efficiency of retort-benches, the improvement of water-gas apparatus over early forms, the utilization of residuals, the use of oxide of iron, and the increasing use of mechanical conveyors and devices, with other progressive steps, have all resulted in recent years, as is well known, in greatly decreasing the cost of making gas. But if inquiry is made as to what material reduction of necessary investment, or what advance, has been made in the department of distribution, it is difficult to point out anything very different from, or notably better than, the practice of twenty, or even more years ago. Substantially the same cast-iron pipes, the same hub-and-spigot joints, the same service-pipes, the same meters, the same equipments in general, and the same low ranges of pressures, are in use to-day as were used years ago. Improvement in distribution practice seems to have been limited to details such as an increased use of governors for the reduction of leakage, a greater tendency to coat wrought-iron mains and service-pipes as a safeguard against corrosion, and a growing use of cement joints instead of lead, hitherto usually employed with cast-iron pipe. While it is a compliment to the efficiency of standard gas distribution appliances that the inventive minds of many years have been unable to bring forth better forms, it is none the less a fact that—because of the continuation of settled forms, and of a lack of improvement—the cost of our distribution systems is to-day, for given volumes of business to be handled, practically as great as ever.

In the United States, the average price at which gas is sold is for various reasons generally decreasing—making it imperative that the cost of gas plants, or any portion of them, be kept down to the least possible amount. Lowering prices and the growing use of gas for fuel are resulting in the handling of larger volumes of gas than heretofore; and the increasing difficulty of laying large new mains, for increased volumes, in streets of the principal cities already well filled with water pipes, sewers, underground conduits of various descriptions, and surface railway tracks, is well recognized. The consolidation of manufacture at central stations is also necessitating larger mains; and the recent rise in the price of iron pipes is making them more expensive than ever. All of these conditions afford the greatest opportunity for some improvement in methods of distribution; and any practical plan that will, in particular, decrease the size and cost of street pipes will be a great progressive step.

Perhaps the most striking feature in the present practice of gas distribution is the extremely low pressure at which gas is delivered—average pressures of 2 to 6 inches of water pressure equalling but one-tenth or one-fifth of 1 lb. steam pressure. If customary pressures could be increased so that pipes of given size would deliver ten to fifteen times the volume of gas now handled, would it not enormously cheapen the costs of distributing systems?

I have given this matter much thought for upwards of two years past, and some time ago reached the conclusion that illuminating gas could just as well as not be distributed satisfactorily at a number of pounds pressure—say, from 10 to 30 lbs.—instead of at but a small fraction of a pound; and that by such plan of working either present pipes could be made to handle several times the quantity of gas now delivered, or else much smaller pipes would serve as well.

On the basis that quadrupling the pressure doubles the flow, other conditions being the same, 27·75 inches of water pressure or 1 lb. steam pressure would double the flow of gas delivered at a pressure of 6 to 7 inches—a not uncommon distributing pressure. And if this 1 lb. be quadrupled, and the pressure be increased until 20 or 30 lbs. be reached, such pressure would deliver ten or twelve times the amount of gas now sent through given sized pipes. While such pressure is enormous, compared with usual illuminating gas pressures, it is very moderate indeed if viewed from the standpoint of (say) steam or water pressures; and if by a simple increase of pressure, by some practical working plan, the capacity of gas-pipes can be so greatly increased, does it not follow that the construction costs of distributing systems may be very greatly decreased, reducing the earning power necessary, and thus, indirectly, the expense of distribution? Appreciation of the saving that may be made may be shown by a few examples.

According to the formula of Dr. Pole, usually employed in such matters, an 8-inch pipe 4 miles long, under present customary pressures of 6 or 8 inches, will deliver at the far end 8000 to 9500 cubic feet of gas per hour. Under a range of 20 to 30 lbs. pressure, and operating (as later described) by well-accepted formulæ for the flow of gas of ·650 gravity in such range of pressure, it could deliver 140,000 cubic feet per hour. A 2-inch pipe 1000 yards long, would deliver 650 to 750 cubic feet, compared with 4600 cubic feet. A 12-inch pipe, 2 miles long, would deliver 33,000 to 38,000 cubic feet, compared with 550,000 cubic feet. To supply gas to a point 4½ miles distant, at the rate of 10,000 cubic feet per hour, on present lines, in a recent instance figured upon, would have required a 10-inch pipe, costing about $26,000. With high pressure, however, a 3-inch pipe, costing but $10,000, gives equal capacity. To supply 15,000 cubic feet an hour at a point 6 miles distant in another instance, required a 12-inch main at a cost of $40,000. While, with high pressure, as hereafter described, a main of only 4 inches diameter would have given the same capacity at a cost of $16,000.

I have recently had occasion to figure upon the construction of a distributing system including 25 miles of pipe in the usual amounts of sizes from 3 to 12 inches in diameter, the estimated cost of which was $82,000. The construction cost of a high-pressure system in the same locality, with pipes ranging from 1½ to 4 inches in size, and including the extra cost of complete pumping equipment and consumers' house regulators, &c., was only $43,000—a saving of about 47 per cent.

This paper is more particularly directed to showing the feasibility of working at high pressure, rather than to the figuring of savings to be made in assumed cases, each of which, whether real or imaginary, would differ from its neighbour, and would have to be figured upon its own conditions. I am assuming that the saving is so obvious, in a system that would make gas-mains of a dozen times their present capacity, that it is not the exact degree of gain to be made that may interest you so much as it is the manner of so operating, and the practicability of such a system. For, on the one hand is an investment which, even after the cost of the requisite pumping machinery and high-pressure regulators and appliances is allowed for, is yet but one-half of that ordinarily necessary; while, on the other hand, the increased operating expense of a high-pressure system—chiefly involved in the running of a moderate sized gas-compressing pump—is so slight as to only fractionally offset, and so small as not to begin to neutralize, the advantage gained.

Illuminating gas, it should be remembered, is the only extensively handled commercial fluid that is delivered at a very low pressure. Water, steam, compressed air, natural gas, Pintsch gas, refrigerating fluids, &c., have been and are being widely distributed, sold, or handled for years in public places, in various of the principal cities of the civilized world, and to such extent and in so many ways as to fully justify the statement that a number of pounds pressure in itself, in such matters, is neither unsafe nor unfeasible. The mechanism and appliances for controlling these various fluids, even at pressures up to several hundreds of pounds, have been well worked out into adequate and standard forms that fully serve the purposes of commercial industries. It is indeed curious, when one reflects upon it, that for so many years illuminating gas has continued to be distributed at but a small fraction of a pound pressure, when all other liquids served by public companies are sent out usually at far greater pressures, and the universal tendency in such things is to increased tension. The reason for the continuance of low pressure with illuminating gas is no doubt the fact that relatively, and in the past before the advent of any great volume of fuel business, the actual quantities of gas required to be handled have been small, and it has been found comparatively easy to provide pipes of sufficient size, and without undue cost, that would convey all the gas required. While such conditions have existed in the past, it is a question whether in the near future, for the reasons already stated, gas engineers will not find it both necessary and profitable to replace pipe *diameter*—convenient but expensive—with readily supplied *pressure* to best distribute large volumes.

While some companies in the United States have slightly increased their pressures to increase the carrying capacity of their street-mains, by the introduction of mechanical appliances, such as rotary blowers, to reinforce the pressure given by the gasholders, it has almost invariably been solely for the purpose of transmitting gas from one distributing point to another, and within pressures not exceeding 50 inches and measured in inches of water pressure; and no general delivery of gas to the customer direct and through all the mains at some pounds pressure has been undertaken to my knowledge. The only instances among the 1000 companies in the United States of which I have been able to learn, wherein gas is being noticeably compressed, in connection with public supply or service are the following.

In Louisville, Kentucky, coal gas has been pumped for about two-and-half years, by a piston compressor of about 30-inch by 36-inch cylinder size, at the rate of about 140,000 cubic feet per hour, through a 10-inch wrought-iron pipe, a distance of some 2¾ miles, for the purpose of filling outlying gasholders—throwing a pressure of 10 inches. In this case no consumers are served along the line; and no loss of candle power has been observed. The initial pressure of 5 to 7 lbs. is only that sufficient to overcome the friction of the pipe while filling the holder against 10 inches pressure at the rate per hour designated.

In Oakland, California, for about ten years a mixed coal and water gas has been pumped by a piston compressor a distance of 8 miles to Alameda, through an 8-inch cast-iron pipe with lead joints; also for the purpose of filling a gasholder at an outlying point. In this instance, the initial pressure carried is 5 lbs.; the terminal holder pressure is 4 inches. No individual consumers are taken off the line, although midway a governor of the Connelly type controls a supply of gas taken from the main for the district of East Oakland. The loss of candle power observed, due to compression, &c., is said to be slight, and not to exceed a quarter of a candle.

In Chicago, Illinois, for some years water gas has been pumped in the southern portion of the city from the plant of the Mutual Company's works, a distance of about 23,000 feet, through an 8-inch pipe-line, for the purpose of filling an outlying holder. In this instance, a rotary exhauster of the Root pattern is used, giving an initial pressure of 10 lbs. and passing gas at the rate of about 60,000 cubic feet per hour into the holder against a pressure of 7½ inches. No consumers are taken off *en route*.

In Danbury, Connecticut, for ten years past a 35-candle power oil-water gas has been pumped under 40 lbs. pressure through a 2-inch wrought-iron pipe by a piston compressor, a distance of 3 miles into stationary wrought-iron tanks. From these tanks the gas, controlled by a governor, is supplied to the small town of Bethel, at the customary low pressure. No consumers are taken off *en route*; and no loss of candle power is observed.

The above cases are far short of the distribution of gas direct to the customer at high pressure; but they are yet of interest in showing that compressing illuminating gas to several pounds pressure causes no noticeable loss of candle power. The well-known Pintsch system of car lighting, so extensively used in both the United States and Europe, for very many years, has moreover fully demonstrated that pumping machinery for compressing gas to almost any pressure can be dependably used in gas undertakings if desired. The hundreds of natural gas companies in the fields of the United States further, have also fully demonstrated that wrought-iron pipes will satisfactorily convey gas any distance, at any pressure, and that mechanical regulating devices or governors will reliably reduce and control pressures to any degree desired.

If, therefore, the compression of illuminating gases to a few pounds pressure does not objectionably reduce their candle power (as indicated in the Louisville, Chicago, Oakland, and Danbury instances cited), and if compressors will readily pump gas (as shown by the Pintsch system), and if wrought-iron pipes and mechanical regulators will suitably convey, handle, and control it (as shown by natural gas undertakings), does it not necessarily and logically follow that by using the compressors of the Pintsch people and the wrought-iron pipes and regulators of the natural gas people, illuminating gas can also be similarly compressed and delivered at high pressure through small pipes if desired? There is but one answer to this question: Illuminating gas can be so served, easily, dependably, safely, and economically, although the realization of this is but dawning.

Considering the above general proposition in more detail, it is clear that the satisfactory distribution of gas direct from the gas-works to consumers at some pounds pressure, in order that they may be safely and well served through mains much smaller than the ordinary, would specifically require: 1. Street mains of long life, with joints originally made tight, and that will stay tight. 2. Machinery for compressing and pumping, in which the likelihood of breaking down is remote. 3. Regulating main governors, reliable in character, for reducing the pressure of the high-pressure line to any desired low (ordinary) pressure in any given district. 4. Individual house governors reliable in character, to enable the supply of customers anywhere along the high-pressure line. 5. Adequate safety appliances; so that in the possible event of any pressure regulating mechanism failing to work, no damage can result other than loss of gas. 6. Means for safely and easily putting in additional service-pipes at any time on the high-pressure pipes while under pressure, without shutting off the supply to existing customers. 7. Freedom from loss of candle-power to any serious extent because of the compression.

Without consuming time unnecessarily by the relation of the detail of extended investigation, I became, and am, convinced: 1. That for high-pressure gas work, wrought-iron screw pipe, well coated against corrosion and carefully laid, will afford a

practically tight system of gas-mains, and will last in most situations sufficiently well. The experience of ten to fifteen years of the natural gas companies and others in the United States, with wrought-iron pipe, gives warrant for this conclusion. 2. That the standard types of air-compressors, built to withstand severe usage in distant mining districts, are, with slight modifications, entirely suitable for pumping gas at some pounds pressure. They are no more liable to breakdowns than ordinary steam-engines; and they can be installed in duplicate at such moderate cost as to completely cover the fullest requirements of safety and insurance of supply. The thousands of air compressors in use throughout the world, as well as the many Pintsch compressing stations, give full warrant for this conclusion. 3. That the district governors and regulators used for years in the natural gas fields in the United States, will control any volume of illuminating gas from and to any range of given and desired pressure. They are so moderate in cost, simple in form, and so compact, as to enable their ready arrangement in duplicate, giving ample opportunity for inspection, cleaning, adjustment, &c. The very extended and satisfactory experience with such regulators by natural gas companies gives warrant for this assumption. 4. That the inexpensive, individual house governors—also used throughout the natural gas districts, with great reliance and satisfaction—will equally well serve with illuminating gas. These governors are practically the same in type as those used on the Pintsch system of car lighting in about 100,000 cars throughout the world, and for many years with an almost entire absence of accident or trouble. 5. That the use of simple forms of oil-seals, or safety vents, will fully protect, as desired, either a district at large or one or more individual customers from danger or damage in the remote (though possible) event of a defective pressure-regulating device working improperly. Such precaution is used in the natural gas fields, and is believed to give entire protection, and has so far been found to do so. 6. That by the use of a saddle or lug bolted on to the gas-main, and a suitable pressure tapping device, service-pipes can be easily added as desired without inserting a T, interrupting the supply of gas, or increasing the expense, and with less danger and trouble than are involved in the present practice. 7. That where high compression—to say 200 lbs.—would seriously affect the candle power of the gas, compression to but 20 or 30 lbs. (provided the gas is an ordinary coal gas or well made water gas) will not decrease the candle power visibly, or over the fraction of a candle, or enough to be an objection commercially.

Having satisfied myself upon all the points as above, fully and in general, that illuminating gas could, with proper equipment, be readily distributed at 20 lbs. pressure, and an opportunity offering, within the past year demonstration was made of my belief.

The towns of Phœnixville and Royersford, 28 miles from Philadelphia, are about five miles apart, and together contain about 16,000 people. Each of these towns has had a Gas Company for many years. Both of the Companies were purchased last summer by the Consolidated Schuylkill Gas Company, controlled by myself and some associates. It was decided to lay a high-pressure connecting main from one to the other, in order that the operation of the smaller gas plant could be discontinued, and all gas making be centred at one point. Between the two stations a 3-inch wrought-iron pipe, 23,015 feet in length, was laid—especial care being taken in making the joints and in testing throughout. When finished, it was tight under 60 lbs. pressure. The pipe was laid about 3½ to 4 feet deep along the line of a moderately hilly country road. It crosses a river 600 feet wide, and railroad tracks and stone culverts at various points. Tees were inserted for customers' service-pipes along the line, together with drips and valves. At the starting point, a compressing pump was installed, having a working capacity of about 5000 cubic feet of free gas per hour. Suitable governors, gauges, and small parts and details were provided. The duty of the compressor is to draw gas from the gasholder and compress and force it through the pipe-line at a pressure of from 10 to 25 lbs., according to requirements, to the town at the other end of the line. At the farther end of the line two regulators or governors, set tandem, are used to reduce the varying pressure of several pounds in the pipe-line to that desired in the low-pressure existing mains—namely, a uniform 2·7 inches. The first governor is adjusted to reduce any pressure ranging up to 50 lbs., down to 1 lb.; and the second governor—more sensitive in its action—is set to reduce the gas at 1 lb. to the 2·7 inches named. Both governors are of the non-freezing, dry-diaphragm type. Suitable gauges for indicating and recording the various high and low pressures, as well as other necessary appurtenances, were provided at the terminal pressure regulating station. Figs. 1 and 2 illustrate the compressing pump and the pressure regulating mechanism respectively.

Construction was finished and operation commenced Dec. 29 last; and from that date since, the supply to Royersford by this pipe-line has been maintained satisfactorily. In the first few weeks, some readjustment of the regulating mechanism was from time to time necessary, until its working and best action were fully understood; and the gas-pump was operated in various ways in order to ascertain the best method of running. No difficulties whatever of importance developed; and, in fact, there was less trouble experienced and experiment required than was really anticipated, or is ordinarily involved in commencing the operation of something out of the ordinary. For the first two months a small gasholder at Royersford was used in connection with the pipe-line, to insure the safety of supply, and until it was felt that the system as a whole was in complete running order. This condition being reached within that period, the gasholder was shut off; and since that time the town has been served with its illuminating gas direct from the high-pressure main through the regulators, from a point nearly 5 miles away, and without the use of a holder or storage receptacle. It is my understanding that this is the first instance of this being done. The gas served is an ordinary illuminating water gas of about 20 to 22 candle power, made from naphtha. The generating apparatus is an old one of the Lowe type, and of inferior design; the superheating capacity being much less than it should be, with the result that the gas made is but partially "fixed." Under these conditions, it would be expected that the compression would result in considerably reducing the candle power by the throwing down of the unfixed illuminants. No particular depreciation in candle power, however, has been observed; the gas at the far end of the line being, generally speaking, of good commercial quality, and of practically the same grade as that delivered at the starting point. While variations in candle power have been noticed, they are due to irregularity in the quality of gas made in, and because of the poor machine so far necessarily used, and not to the fact of compression. I regret to say that, owing to local and other reasons, it has not yet been possible to have close photometrical observations made.

The gas-pump has a capacity of about 100,000 cubic feet per day, at a speed only 75 per cent. of its rated speed. As this quantity of gas, however, is as yet not required, it has been found the most desirable plan to operate it for from 30 to 45 minutes every two hours or so—pumping and storing gas in the pipe-line to a pressure of 25 lbs., and letting that gas furnish the supply until the pressure falls to 5 lbs., when pumping is resumed. The temperature of the gas is increased by the compression to about 120° Fahr. The volume of drip or condensation removed from the pipe-line is about ⅛ gallon per 1000 cubic feet. The

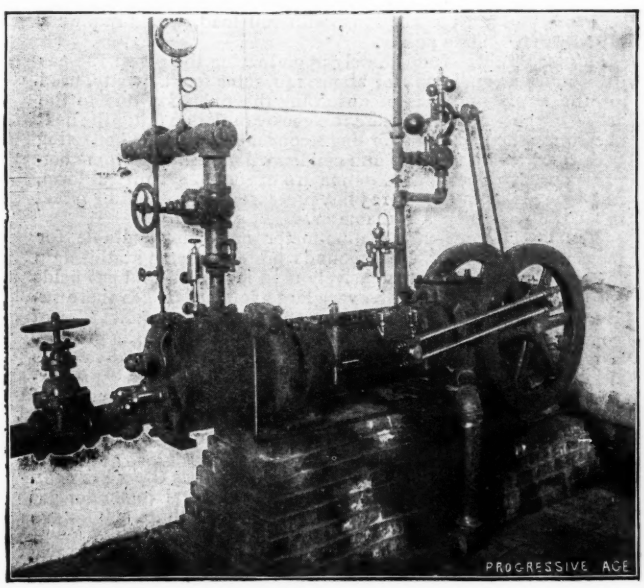


FIG. 1.

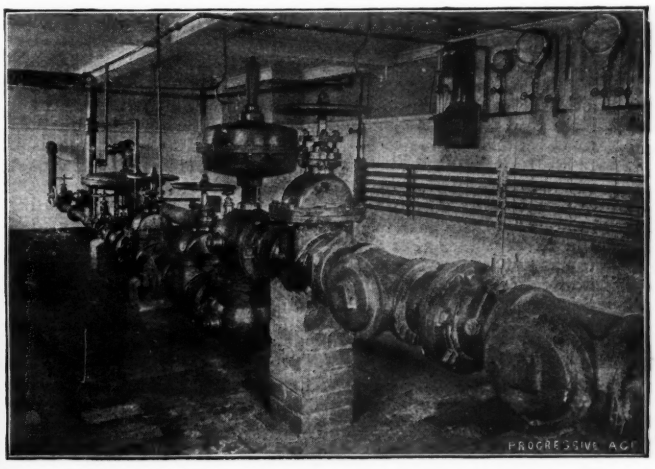


FIG. 2.

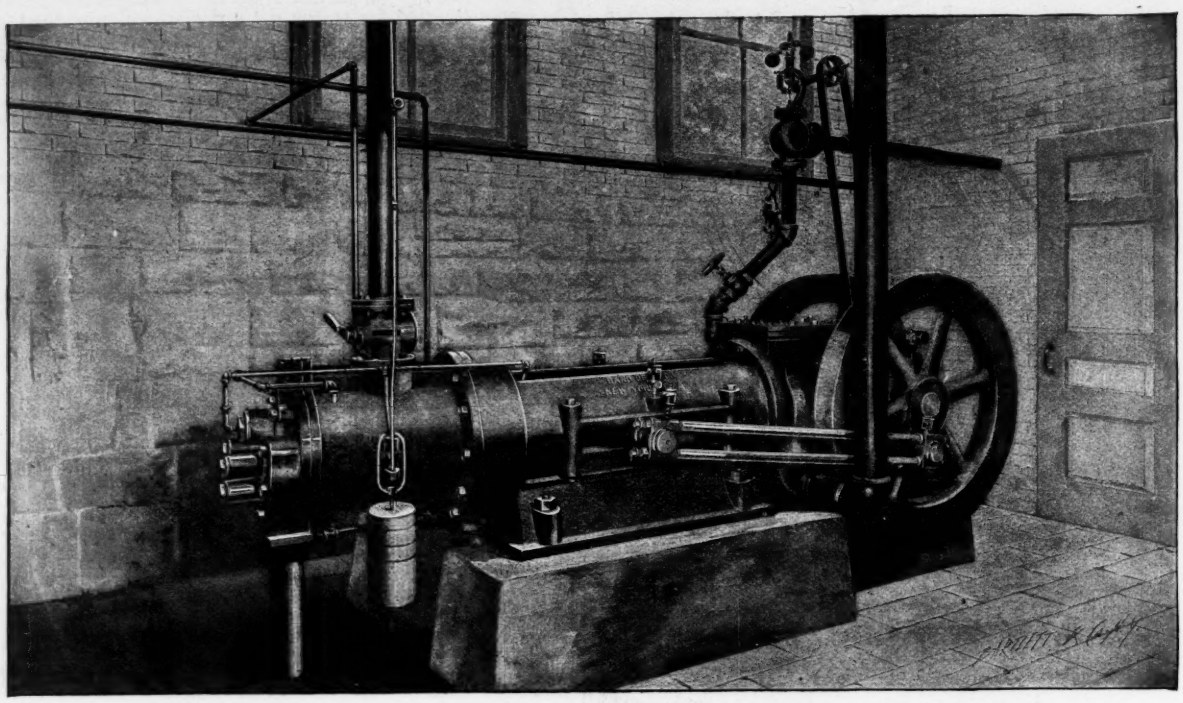


FIG. 3.

loss of pressure, due to friction in the pipe-line, is from 2 to 3 lbs. While the general capacity at present is about 4000 cubic feet per hour, by increasing the speed, governor adjustment, &c., and by the use of a larger pump, the line will handle two or three times that amount in the future, if desired. Along the high-pressure pipe-line a number of customers are served by means of individual house regulators, reducing the pipe-line pressure, whatever it may be, to 17-10ths water pressure. One regulator controls a single lamp-post only; another a large county almshouse; a third a run of 800 feet of pipe serving about seventeen houses; a fourth the lighting of a bridge. All these regulators have worked satisfactorily continuously.

The sceptics as to the success of pumping illuminating gas at high pressure predicted that there would be a considerable loss of candle power due to the compression; that the governors would not be reliable; that condensation would give trouble; that the high pressure in the pipe would be dangerous; and that break-downs of the pumping machinery would imperil the general supply. Neither these nor other troubles have materialized or appear to be in sight.

The operation of the system has been so continuously and so generally satisfactory that the owners of the Company have decided to duplicate it on a much larger scale in the extensive suburban districts of Darby and vicinity, immediately adjoining the city of Philadelphia. Work is under way in the district upon an initial system of about 22 miles of high-pressure pipe. The trunk-line from the gas-works is 6 inches in size, and extends to a point 3 miles distant; and from that point two lines of 3-inch and 4-inch pipe further extend respectively to points 7 and 8 miles away from the gas-works. It is expected that upwards of a thousand customers will be receiving and using gas from this system within a year's time, and that it will make a still further demonstration of the low investment with which gas can be served at a distance and in a scattered district, by means of high pressure. The various towns and villages within the territory in question (which is about 8 miles long by 3 to 4 miles wide) are as yet but thinly built up, and are so scattered that it would not have paid to pipe and connect them together, or been possible to as yet secure the gas business therein, if it had been requisite to lay the large and expensive cast-iron mains that the distances would have made necessary on ordinary lines.

The operation of the Phœnixville high-pressure distributing system has further been so satisfactory that the owners also of the River Shore Gas Company, serving gas in several small towns not far from Philadelphia, in the state of New Jersey, are now completing, under my supervision, a pipe-line for the purpose of transmitting gas from their works at Riverton to the town of Moorestown, about 4½ miles distant. This equipment is almost identical with that at Phœnixville in the use of a 3-inch wrought-iron coated screw-joint connecting pipe, in the use of governors along the line and at the far end for controlling all pressures, and in the entire absence of the use of any storage holder or receptacle whatever at the far end.

The equipment of high-pressure lines as above, with the accompanying minor parts, either necessary or desirable, may be conveniently divided into three principal parts: 1. The compressing machinery (in duplicate), including a continuous steam supply, water jacket, speed and pressure governing mechanism, recording pressure-gauges, thermometers, low-pressure safety-alarms, pulsation and condensing tank, and meter. 2. The pipe-line, including the matters of coating, joints, testing, drips, valves, service saddles, house pressure-regulators, high-pressure house-meters, and individual house safety appliances. 3. Main line regulators (in duplicate) and terminal station, including indicating gauges, recording pressure-gauges, thermometers, test-lights, purge and vent facilities, photometer, safety seals (main line), high and low pressure alarms, bye-passes, &c.

A description and illustration of the principal items above will perhaps convey a fair idea of the design and character of the machinery now being used by the writer and those associated with him in the United States for high-pressure illuminating gas distribution.

The Compressors.—Straight-line, steam-driven, water-jacketed, horizontal Rand compressors are used, of the type shown in fig. 3. A machine having a gas cylinder 8 inches in diameter by 12-inch stroke, operating at 140 revolutions a minute, has a practical working capacity of about 5000 cubic feet per hour, weighs 2100 lbs., occupies a floor-space of about 2 feet by 8 feet, and requires 18-horse power at full load. A machine of about eight times this capacity, or over 1,000,000 cubic feet per 24 hours, would have a steam cylinder probably of 16 inches diameter, a gas cylinder of 21 inches, and a stroke of 24 inches. It would weigh about 18,000 lbs., occupy a space of about 16 feet by 4 feet, and at 95 revolutions, with full load, would require a little over 100-horse power.

Pulsation Tank.—Immediately upon leaving the pump, the gas passes into a small tank of about 140 cubic feet capacity, used for the triple purposes of absorbing the pulsation due to the action of the pump, of cooling the gas by radiation (after the heat of compression), and of affording a convenient point for collecting and withdrawing the drip and condensation resulting from compression. The tanks used by me are of simple cylindrical form, of ⅜-inch steel, tested to 125 lbs. pressure, and measuring 9 feet in length by 55 inches in diameter.

Meters.—The ordinary station-meter not being suitable for measuring gas under many pounds pressure, I am at this date installing an appliance extensively used in the natural gas fields for the measurement of the very large volumes of gas there involved. In order to avoid the great expense and difficulties of constructing meters large enough to measure all the gas passing, a most ingenious arrangement of differential balanced-valve is used, inserted in the run of the pipe, and styled a "proportional meter." In this a fixed portion (usually 1 per cent.) of the passing gas is always diverted through, and measured in, a small positive meter, connected and accompanying, irrespective of what the volume of gas may be that may at any time be passing. The index of the meter that measures the 1 per cent. also multiplies the result, and indicates the total volume of gas that is passing. The writer is informed that these meters are ordinarily and reasonably accurate and reliable.

Fig. 4 illustrates the Westinghouse form to be used in the high-pressure plant at Darby, now building. Fig. 5 illustrates the Wylie form, to be used in the Riverton works mentioned. These meters are generally similar in purpose and result.

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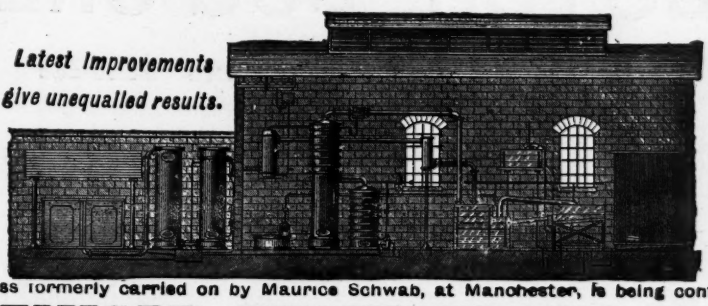

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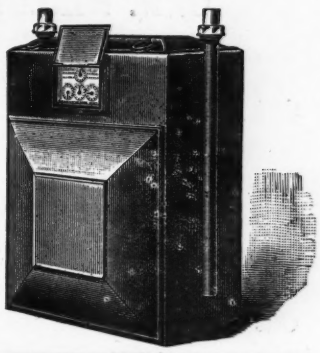

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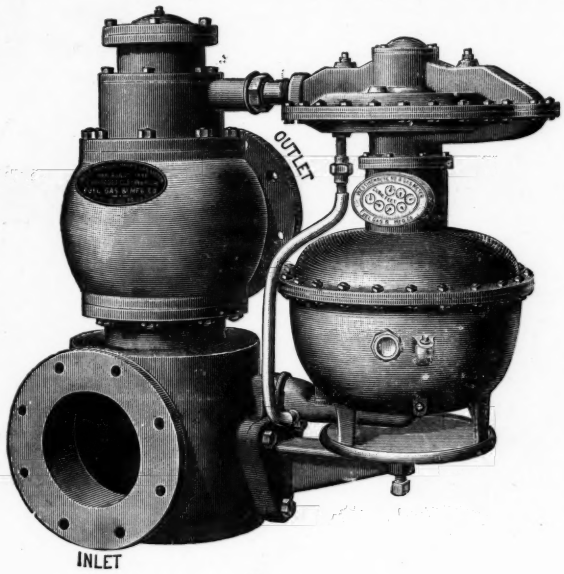

FIG. 4.

exceeding 3 feet square by 3 feet in height being sufficient to contain one of a capacity of 50,000 cubic feet per hour. Connections run from 3 inches to 16 inches.

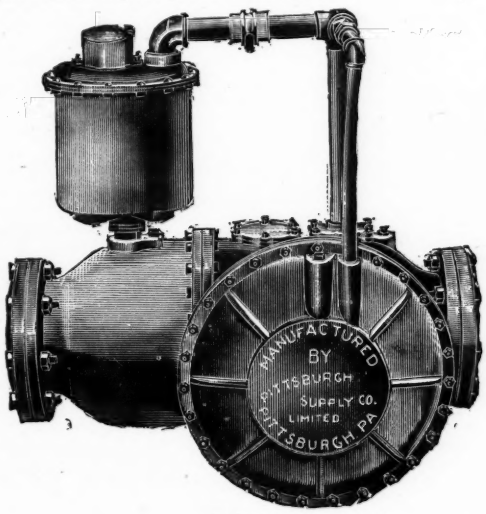

FIG. 5.

Main-Line Regulators and Governors.—For the purpose of reducing pressures from 50 lbs. or 100 lbs. down to a very few pounds, say 5 lbs. or so, the appliance used in the Phœnixville plant, and perhaps the most common one in the natural gas fields, is that known as the Fulton regulator—fig. 6. This is

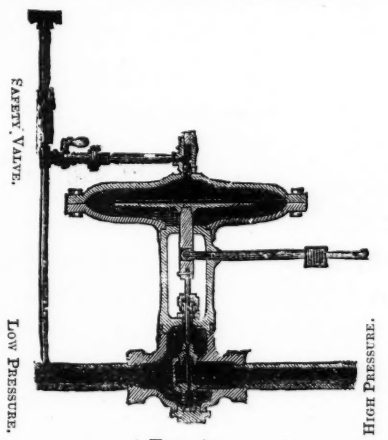

FIG. 6.

an automatic, vertically moving valve, operated by the action of a diaphragm above, which in turn is actuated by the gas pressure from the low side of the regulator. The action of the mechanism is very perfect and complete. It is made with connections of from 1 to 16 inches; and the smaller sizes occupy a space of less than 3 feet square. For the regulation of pressures of a few pounds only, ranging from 2 to 10 or 20 lbs., a form of diaphragm governor is also commonly used, which reduces such pressures to a few inches water pressure, and holds the same very accurately to any point desired. Fig. 7 illustrates another

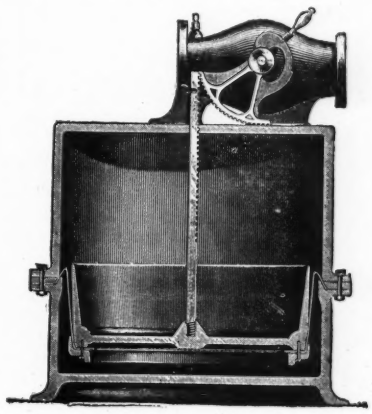

FIG. 7.

form, known as the Union, in which the valve is operated by a floating bell in the tank adjacent. Fig. 8 illustrates a very convenient arrangement of diaphragm governors in duplicate, used

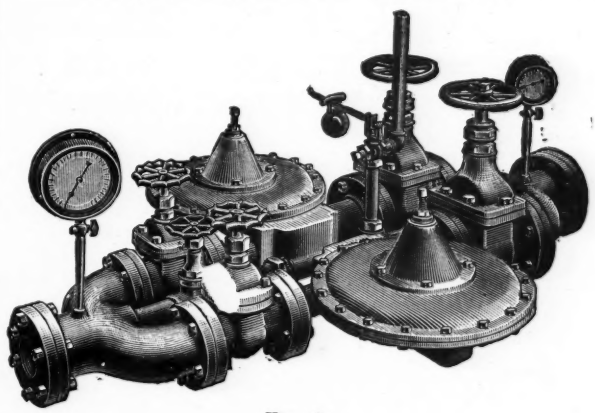

FIG. 8.

by the River Shore Gas Company, at the terminus of the 3-inch pipe-line. The entering gas at high pressure can be diverted through whichever governor it is desired to have in use, the other governor being out of use and affording every opportunity for cleaning, examination, adjustment, &c. Bye-pass safety vents, pressure-gauges, &c., are all conveniently provided in this equipment, which is known as the Johnson-Reynolds "double low-pressure station."

The sensitiveness of operation of such governors as are above described may be clearly seen in the reproduction of sheets from the recording pressure-gauge, shown in fig. 9—next page. These show the pressure maintained at Royersford on the far side of the low-pressure governor, for example, for the week ending May 23 last. The record for the 19th and 20th was made on the same disc. It will be observed that the ink-line for the 20th was super-imposed over that for the 19th; and that all the lines for the entire week could be super-imposed one over another without showing the slightest deviation from the true circle that records the fact of the maintenance of 27-10ths pressure continuously. The variation in pressure is so slight that the marking pencil does not show more than one-half of a tenth of an inch water pressure, which variation amounts to nothing. This is in spite of the fact that the pressure controlled by the regulating governors is constantly varying according to whether the compressor at Phœnixville is pumping gas into the line and increasing the pressure, or whether it has ceased and the pressure is falling by reason of consumption. The record of such constantly rising and falling pressure in the pipe-line is well shown in a sample sheet for May 23—in fig. 10, p. 775. It will be observed as ranging from 5 to 30 lbs.

Main Line Safety Seal.—Immediately beyond the second regulator at Royersford, a side connection or spur from the low-pressure main is taken off in the regulator-house, and led into a small pot or vessel near by containing oil. This pipe seals a few inches in the oil, precisely as the dip-pipe of a bench seals in the hydraulic main. From the crown of the vessel, an open discharge pipe leads through the roof. The oil-seal forms a safeguard against the possibility of the high pressure of the pipe-line getting into the low-pressure pipes beyond, to the

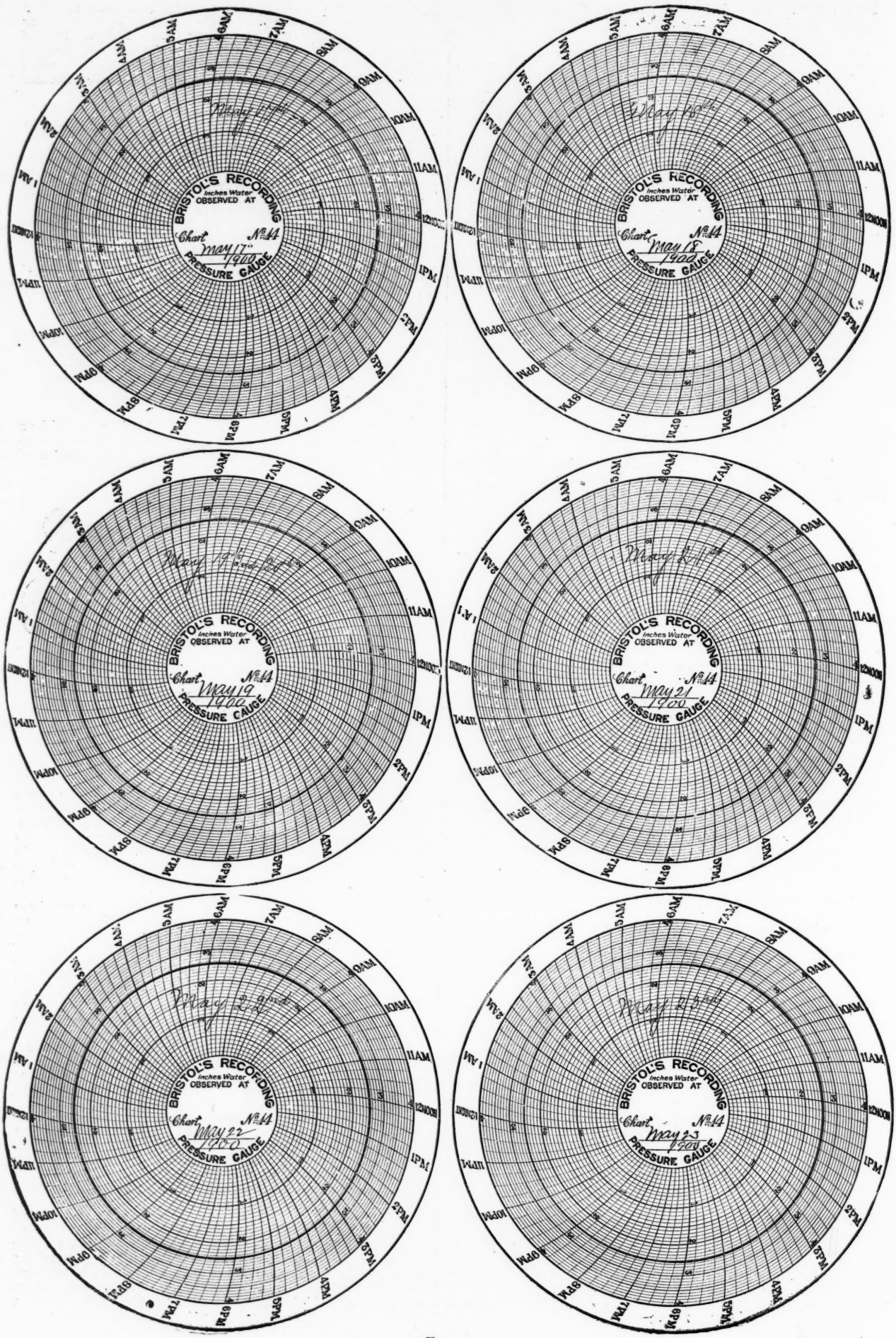
BRISTOL'S RECORDING
Inches Water
OBSERVED AT
Chart No. 14
PRESSURE GAUGE
May 17th 1900
May 18 1900
May 19 1900
May 21 1900
May 22 1900
May 23 1900

FIG. 9.

damage of the meters, &c.; as, if the regulators should at any time get out of order and fail to work, and the high pressure should get by, it would immediately break the oil-seal and discharge through the stand-pipe into the atmosphere. This

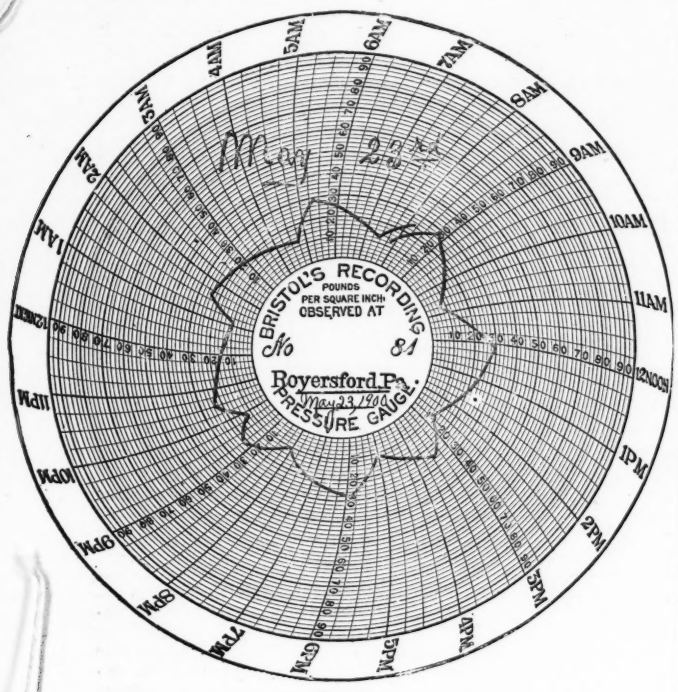

FIG. 10.

simple provision, it is felt, affords entire safety against serious accidents that could otherwise be possible. The oil used in the seals is of a character that will neither evaporate nor freeze.

Services.—Consumers' service connections on the high-pressure pipes are made by the use of saddles, as illustrated by fig. 11, bolted on to the pipe. The saddle is threaded for receiving the connecting fittings; and after being placed in position it requires only the boring of a hole through the wrought-iron pipe to give a full supply of gas. Special tools used entirely prevent the escape of gas in making connections.

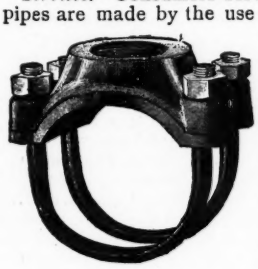

FIG. 11.

House Regulators.—Small sizes of the low-pressure main-line regulators are used universally for controlling the pressure in houses along the line of high-pressure mains wherever desired. These are made in a variety of forms; but they have nearly always a cast-iron case of from 5 to 15 inches in diameter, and stand any ordinary pressure. They contain the governing valve and diaphragm. Threaded to fit the standard pipe from ⅜ inch to 2 inches size, they are readily connected in the run of any service-pipe taken off a high-pressure main, and afford a capacity according to size of from (say) 25 to 2000 cubic feet per hour. As a class, they are extremely sensitive, simple, accurate, and reliable in operation.

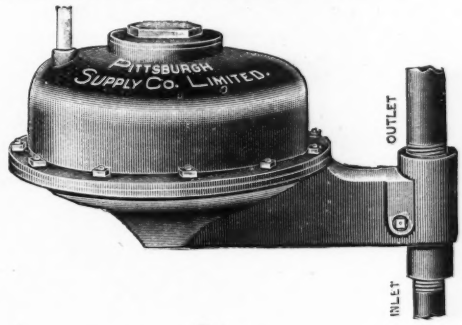

FIG. 1 ;

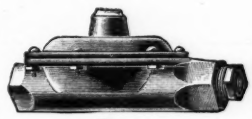

FIG. 13.

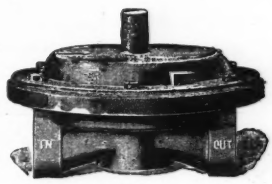

FIG. 14.

Fig. 12 illustrates the "Equitable," fig. 13 the "Johnson-Reynolds," and fig. 14 the "Westinghouse"—all representative and widely-used patterns.

High-Pressure Meters.—While I have so far used the ordinary tin-case meters, following the house regulators as above, and protected by safety-seals intervening to guard against the possibility of pressure getting past the regulators and into the consumers' meters, it is likely that there will later be used, to a greater or less extent, some of the forms of cast-iron meters built to withstand 20 or 30 lbs. pressure in general use in the natural gas regions. Fig. 15 illustrates the Westinghouse meter of this character.

The iron case contains a floating inverted bell, divided into chambers and sealed in oil in the lower half. This bell rotates with an undulating motion; the compartments filling and emptying in succession through a central common valve. This form of meter has no leather diaphragms, is made entirely of metal, in sizes of from 200 to 40,000 cubic feet capacity per hour, and in diameters ranging from 1 to 5 feet.

The Equitable meter, illustrated in fig. 16, is also made with a cast-iron case, but is of the dry pattern, with leather diaphragms, arranged vertically around the periphery—in turn filling and discharging on the lines of the ordinary meter. This pattern is made in sizes of 300 to 1200 cubic feet capacity per hour.

A very extensively used form, shown in fig. 17, is known as the "Tobey," in which the cast-iron case is globular, and contains three diaphragms connected with a central spindle operating the index above, and valve mechanism in the base of the meter.

Recording Gauges, &c.—Fig. 18 shows the arrangement of gauges at the terminal stations of the high-pressure station at Royersford. An ordinary steam-gauge indicates the high line pressure of 10 to 20 lbs.; an ordinary syphon-gauge the low pressure of 27-10ths; a similar gauge, with mercury, the intermediate pressure between the high and low pressure regulators

FIG. 15.

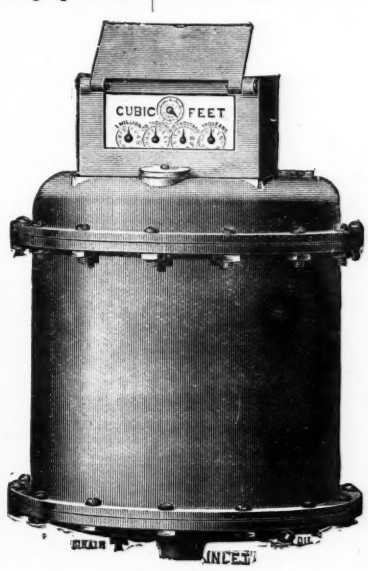

FIG. 16.

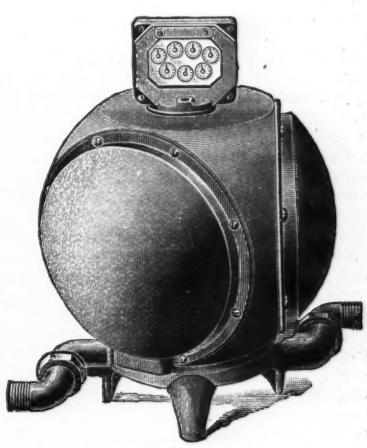

FIG. 17.

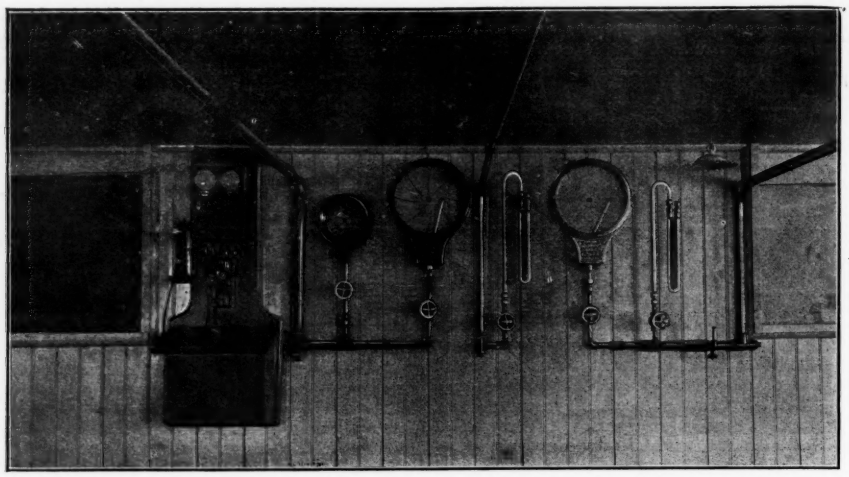

FIG. 18.

Bristol recording gauges (registering the high and low pressures and test lights, telephones, &c.) are conveniently near.

Enough has now been said to show that distribution at high pressure is not only a matter of theory, but, to some extent at least, is already an accomplished fact as well. The Phœnixville plant since Dec. 29 last has been so operating and distributing gas at many pounds pressure some miles away, through small wrought-iron pipes and without storage holders or tanks—precisely as natural gas is distributed. The two other plants named will also, before this paper will be publicly read, be so operating.

High-pressure distribution (crude and rough compared with the future, but yet effective and satisfactory) has been commenced; and if what I have suggested and described shall be the means of interesting the attention of the members of the Congress, and shall lead to the adoption and improvement of the plan by others, and the expansion of "high-pressure" working, with the economy and satisfaction that I am so certain will be found, my gratification will be great.

IN WHAT MANNER CAN THE NORMAL LOSS OF GAS IN DISTRIBUTION BE MOST LARGELY DIMINISHED?

By P. H. GIBBONS, of Philadelphia.

[A Paper prepared for the International Gas Congress at Paris.]

The question of loss of gas in distribution engages the earnest thought of the gas engineer as he looks around for a suitable site upon which to erect a manufacturing station; and it remains a subject of his solicitude until the last pound of coal is carbonized, and the last foot of gas passes the consumer's meter. Fortunate is he, indeed, whose station commands the lowest point in the district to be supplied. For him, the law of gravity renders valuable assistance in furnishing gas to his patrons at a minimum of pressure. Lowness of the site, however, is not the only point to be considered for the economy of distribution. It should be near the centre of consumption as well; for it is a well-known fact that gas decreases in illuminating power in proportion to the length of mains through which it travels, and in proportion to the loss in illuminating power has been the percentage of loss of those gases which impart luminosity to the flame.

There are ample evidences of this fact in the oily deposits found in the drips and meters, and in the deposits of naphthalene crystals observed everywhere along the line of distribution. I have noticed that naphthalene is most troublesome in a coal-gas works between the months of June and September; and this fact, coupled with my five years' experience with a steam-jet exhauster, has led me to believe that the sudden appearance of naphthalene, so often told by engineers in their works, clogging holder inlets and outlets and mains and services, is entirely due to the fact that their condensing apparatus is not receiving proper attention. Steam is keeping too late hours with their gas; and I feel like saying to all such: "Spend a portion of the time that you take to worry over the pranks of this pesky naphthalene in looking after those in charge of your condensing apparatus, and I feel assured that, instead of filling up your pipes and fittings, this hydrocarbon will journey on through the consumer's meter—contributing to his contentment by increasing the power of his light, to your joy by reducing the normal loss in distribution."

Gasholders, as they are now built, maintain constantly the maximum of pressure; and from any little chinks, cracks, or crevices in the seams and around the rivet-heads of their crowns and circumferences, gas will escape in amazing quantities in the course of a year. Here there is no clay, no gravel, no ashes to impede its progress. Once out, it is freer than the air. It is up and away beyond the reach of the olfactory organs of the gasman. Hence it is that special care should be taken in the construction and maintenance of this portion of the distributing system. While the street-main governor is not so important as it formerly was, on account of the different purposes for which gas is now used demanding more pressure during more hours of the day and night, greater precautions should be taken in the laying of mains and services to counterbalance this difference. Leaks are found in street-mains most frequently at the joints. A multiplicity of joints, therefore, means a multiplicity of opportunities for leakage; and I consider it sheer folly for any engineer to lay parallel mains to help supply a district when the old one becomes too small to meet demands upon it. He simply multiplies by two (*plus* the extra joints where connection is made at intersections) the opportunity for leakage. He should abandon the old main entirely, and replace it by one of ample size.

Leaks at the joints in gas-mains are caused by contraction, unequal sagging or settling, and incompetent or indifferent workmen. Leaks are caused by contraction of metal, either through ignorance or carelessness of those left in charge of the operation. I have seen length after length of gas-main exposed to the rays of the hot sun for several hours quickly lowered into the trench, and as quickly yarned, cast, and caulked, and then left exposed to the sun's rays for several more hours before a shovelful of covering was thrown upon it. I am morally certain that, when the temperature of those pipes was reduced, the contraction of the metal started the lead, and leaky joints followed. As soon as a pipe is laid in the trench and set to grade and direction, it should have a light covering of earth thrown over a portion of its surface before the joint is cast. Sags in gas-mains are usually due to improper blocking, to excavations made below its bed for sewers, water-mains, conduits, &c. Leaks from this source can be greatly reduced by having a tacit understanding with the city authorities that a certain defined portion of each new street shall be reserved for gas-mains, and shall not be encroached upon by sewers, water-mains, and the various electrical conduits; and by keeping a competent inspector constantly on the ground where excavations are being made in the vicinity of gas-mains, who should be provided with ample material and assistants for shoring the pipe and re-caulking the joints where necessary.

The fact that pipes laid in the earth are quickly hid from view, and the character of workmanship expended on the laying is so little criticized, encourages many men to seek positions as caulkers and pipelayers who are totally unfitted for the work. There ought to be some standard of efficiency required of every caulker. For example, if a gas engineer were to say: "I will hire no man to caulk a joint on the mains of my company whom I would not and could not freely trust to caulk the joints of the sanitary plumbing of my own private residence; I will retain in my employ no man who is so indifferent to my interests and the interests of the company whom I represent as to make frequent trips to the gin shop and the beer saloon during working hours"—I believe that the engineer who would exact these two requirements of caulkers could safely say: "There are no leaks at the joints on my mains due to careless or incompetent workmen." In my experience, I have been able to trace much of the poor work on services and mains to over-indulgence in intoxicants during working hours.

Leaks in gas-mains are frequently due to breaks which are caused by external pressure, by forcing fittings into holes in the main that are not sufficiently tapped out, by drilling too large holes, and by uneven sagging. The first cause can be entirely avoided by laying the mains—smaller than 6-inch especially—under 3 feet of cover. The second cause is evidence of the fitter's incompetence, and the remedy suggests itself. The third cause can be entirely obliterated by placing a tee in the main where a large tap is required, or by re-enforcing the main with a split sleeve, with a hole of the desired size tapped in it. The loss of gas from the making of taps for services, repairs, and

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INSTRUCTIONS.

The Brass Plate has holes around its edge, numbered; these indicate the feet delivered for the Coin used To set the Meter, note Figs. I., II., III., IV.

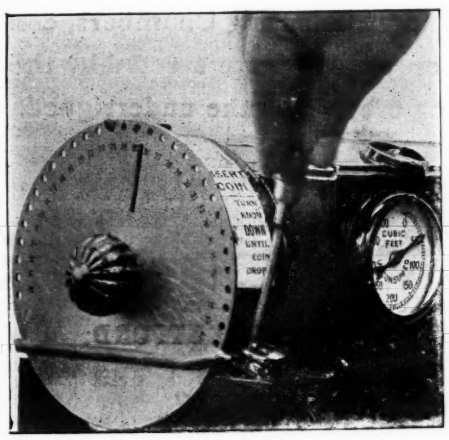

Fig. I.
Break Company's Seal and Remove Screw—THUS.

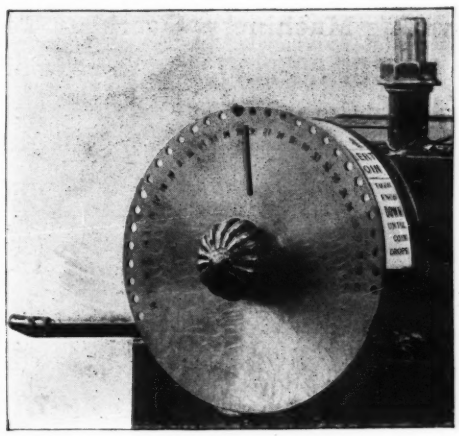

Fig. II.
Swing Band Back—THUS.

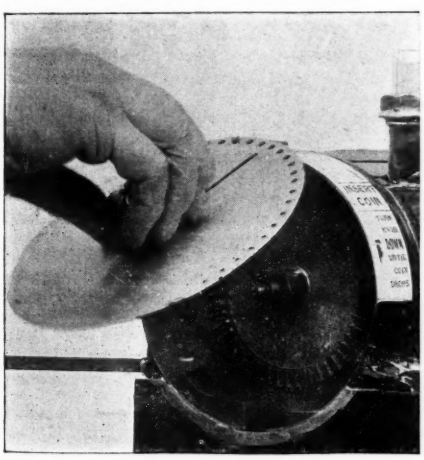

Fig. III.
Lift Plate Off—THUS.

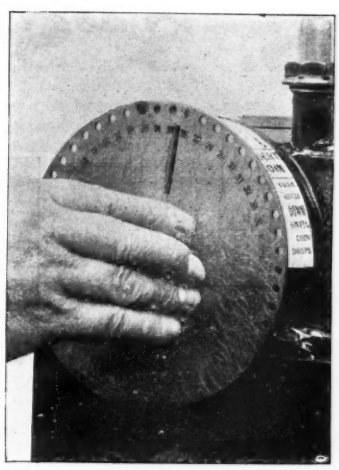

Fig. IV.
Replace Plate—THUS.

Swing Band Forward—Replace Screw—and Re-seal.

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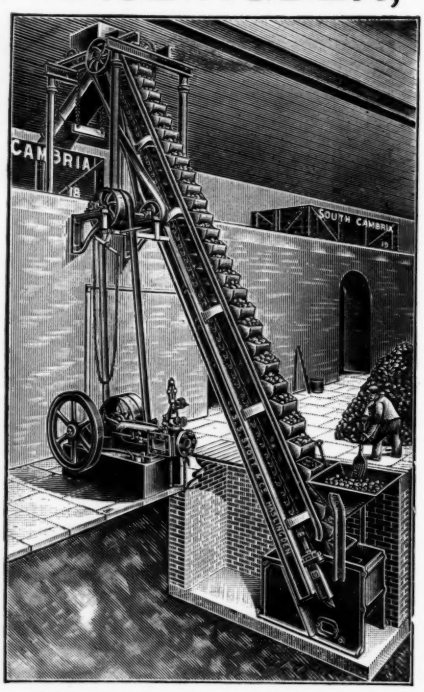

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extensions, which was considerable a few years ago, can be greatly reduced by the use of combination taps, gas-cups, tallow, cloth, rubber bags, plugs, soap, and other devices that are familiar to modern gasmen. I believe that it would be a wise precaution to place vent-boxes over all mains at intervals, for the future detection of leaks, on all streets where traction, telegraph, and telephone conduits and electric light cables make it extremely dangerous to bare the mains for leaks. The same precaution should be taken on all streets that are paved with asphalt, cement, and vitrified brick, that have a concrete base. These vents need not necessarily be large; and I am sure they would materially aid the gas engineer in keeping down his percentage of loss where those conditions exist.

Leaks are found more frequently on the smaller-sized mains, which is entirely due to their fragility and the want of the same care taken in laying and caulking them that is bestowed on mains of greater dimensions. Cast-iron mains and services under 3 inches are too small, and fail for use underground; and they should not be employed, for they will sooner or later cause trouble and expense. A large percentage of the loss of gas in distribution occurs in the service-pipes; and much of this leakage can be traced to incompetent and indifferent workmen. Here, again, the knowledge that bungling work can be quickly hidden from the eye of competent critics induces men with little or no mechanical skill to apply for positions that they would not dare to fill if the result of their labour was to be exposed to constant view. It is an important work to lay services, and competent men should be engaged to do it; for not only the profits of the gas company are influenced by the manner in which it is done, but precious lives are menaced as well. This latter fact has been forcibly impressed upon my mind during the past nineteen months. I have had ample opportunity to note the character of the service work done in this city. I have seen thousands of service-pipes uncovered for renewal. Many of them were lashed to the main with wire and twine, to keep them in place; other fittings were wrapped as you would wrap a poorly-fitting bung for a barrel, and then pressed into the hole in the main, with a smear of white lead and clay to complete the joint; and in very many cases the formality of screwing the ells, nipples, and spring bends into the main was dispensed with. They were simply driven into the main with a hammer.

Leaks in service-pipes are found most frequently at their connection to the main, at the curb-cock, and in the malleable fittings. Leaks at the juncture of service and main are usually due to the main pipe settling, to tapping a hole too large for the fitting, and to sand holes in the malleable fittings. When a hole in the main is too large to make a safe joint, it should be reamed and tapped to the next size. The danger of pulling services by sagging mains can be minimized by the use of the swing joint or service tee and ell. Too much care cannot be taken in the selection of curb-cocks. They should be well made, and of extra heavy material. Many engineers have abandoned their use entirely, except on services of the largest size. This practice, however, can hardly be considered safe in large cities, where big fires are frequent, which often spread so rapidly as to preclude the possibility of shutting the gas off from the inside of the buildings. I confidently look forward to the time when the curb-cock will be substituted by one that will do the work better, and that will be less liable to leak and less troublesome to get at. In this age, we have automatic fire extinguishers and automatic gas-meters; why not have automtic gas-service cocks?

Since a difference in the temperature of gas registered at the station meter and the same gas registered at the consumer's meter makes a difference in its volume, care should be taken in the laying of services, the connecting of street-lamps, and the placing of meters, to avoid changes of temperature that would adversely affect the interests of your company. This can to some measure be done by laying the services under a good depth of covering—in this latitude not less than 18 inches in the shallowest place; by the use of the anti-freezer or enlarged pipe at the bottom of the lamp-post; and by impressing upon every consumer the importance of having a suitable place provided for the meter. The running of service-pipes through cold vaults and area ways should be avoided as much as possible; and where it is necessary to so run them, they should be protected with a covering of some kind.

Instead of having a number of services and meters scattered around in odd corners and awkward places in buildings that have been enlarged or remodelled, put in one service of ample size, and connect all the meters to it by means of a header. If the house-risers are scattered along the front walls of the building, bring them to your meters and one service. It will be more economical for you to do this. Your meters placed side by side on an even shelf look businesslike, and become an advertisement of your mechanical skill. In this way, you lessen the opportunities for leakage by reducing the number of joints and fittings and the number of taps in your mains. You lessen the amount of condensation by decreasing the number of feet of pipe through which the gas travels before reaching the consumer's meter. You lessen the loss in distribution by the opportunity afforded to so place the meters where a difference of temperature will least adversely affect the percentage of gas accounted for. You also lessen the liability of loss of meters and gas in case of fire. The turning of one stop shuts off all the gas entering the building; and the meters being concentrated, their removal can be more quickly accomplished.

Malleable iron fittings frequently contain small sand holes, which, being filled with dust and grease, often escape the eye of the most careful observer. For this reason, I would advocate the use of galvanized malleable fittings for service work, because in the process of galvanization these small holes are completely filled with metal.

I have noticed that the life of plain iron pipe laid in coal ashes and ground that has been filled with the ordinary refuse of a city is very limited (sometimes not extending over a period of five or six years), while galvanized water-pipe laid in the same earth at the same time is still in a fair state of preservation—indicating that its life will cover a period of three or four years longer. And from these observations I am led to believe that galvanized pipe should be used exclusively for gas-service work, especially in districts where made-earth of this character is known to occur frequently.

The practice in vogue here at present is to apply several coatings of a tar preparation to the plain iron pipe, after which the service is wrapped with muslin, over which another coating of the tar preparation is spread. This process seems to be very effective. I have examined service-pipes that were two years buried in coal ashes, and found them in an excellent state of preservation. The cloth wrapping was nearly all rotted away; but the pipe had no sign of rust on any part of its surface. The regrettable feature of the process is that you cannot always apply the wrapping and the additional coating to the whole of the service-pipe. It frequently happens that where the pipe needs protection most it gets none—a contingency that does not arise where galvanized pipe is used.

People spend considerable sums of money to have fine cement and flagstone footways laid before their residences and places of business. Once down they are averse to having them broken or disturbed; and we are obliged to respect their wishes. In the event of either driving or boring the service-pipe through the ashes, brick-bats, and broken stone which usually form a base for these footways, the first coating of the tar preparation is worn off. The result is that one-half of the service may remain for twenty or even thirty years in an excellent state of preservation, while the life of the portion imbedded in the ashes without protection will not extend beyond five or six years.

I have frequently observed that service-pipes rust out and leak just inside the cellar wall, while the rest of the pipe is in good condition. Leaks at this point, which are quite frequent, could be greatly reduced by applying a coat of paint to the service at this point from time to time.

Gas-meters—like clocks, watches, and other mechanical contrivances—are very apt indeed to run slow much oftener than they do fast, when their mechanism becomes worn and old and sometimes a very considerable portion of the loss in distribution can be traced to this source, which can be minimized by systematically overhauling all meters that are in use at least once in every four years.

I believe much good can be accomplished by noting on the record of each service the kind of earth in which it is imbedded. If this were done, you would in a few years, by careful observation, be enabled to determine with some degree of exactness the life of your services along the line of distribution. I have uncovered service-pipes said to have been down forty years, and found them in a fair state of preservation; others, again, that had only been down ten years, had not a sound spot in them. Hence the importance of knowing what part the soil in the different sections of the district is playing in the ruin of your distributing system. Much good can be accomplished by encouraging people to promptly enter complaints at the gas office as soon as they detect the odour of escaping gas on their premises or in the street, and by systematic examinations of all joints, pipes, and fittings exposed by the gas companies employees at all times.

Before closing, I feel I ought to say that I am not insensible to the fact that some writers attribute much of the leakage in the joints of gas-mains to expansion and contraction due to the difference in the temperature of the earth in summer and winter seasons. In proof of this theory, they call attention to the fact that small leaks are more frequent in gas-mains than they are in water-mains, which is due (so they contend) to the difference of temperature being greater in the gas than in the water mains. I have always questioned their proof, and therefore have not taken kindly to their theory.

He is a very dull plumber or water department employee who has not discovered that a small quantity of common salt applied to a weeping joint at the bell or ferrule of a water-main will stop the weeping long before its presence can be detected from the surface. The fact is frequently made use of by plumbers and water departments. And even if small leaks of this character escape their observation, the earth surrounding the leaky joint furnishes sufficient corrosive substances to stop small leaks in water-mains. These, in my judgment, are the best reasons why small leaks are less frequent in water than in gas mains. Gas is a more subtle prisoner than water. It spreads an oily film over the small aperture through which it escapes into the earth, that defies corrosion.

In concluding, let me hope that I have expressed some thought, or made some suggestion, that will aid the gasman in reducing the normal loss of gas in distribution. This much accomplished, I shall feel amply repaid for the time spent in preparing this paper for the International Congress of the Gas Industry.

TECHNICAL RECORD.

EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.

The Twenty-fourth General Meeting of the Association was held last Wednesday at Spalding, of which town the President, Mr. J. G. Hawkins, is the Gas Engineer and Manager. Assembling at the gas-works about one o'clock, the visitors were received by Mr. G. F. Birch, J.P., the Chairman of the District Council (who are the owners of the undertaking), other members of that body, and the President.

Although not of great magnitude, in his works Mr. Hawkins had much of interest to show the members. Under his guidance, the works have been practically remodelled. Throughout they bear the imprint of a progressive gas-engineering mind; and there is something about them which reveals an almost affectionate regard on the part of the chief. On entering the works, the members came across a relic of the past in the shape of an old bench of direct-fired retorts, which in an integral state will soon be known no more—in fact, the process of dissolution has already commenced. The reason for this is not far to seek; for a few steps away the visitors were taken into a splendidly designed and well-equipped retort-house, which was built under Mr. Hawkins's direction, and was brought into use some two years since. The house contains seven beds of seven retorts each, heated on Chester's system. Two scoops full of coal (or 3¼ cwt.) form the charge. One of the features of the house are the "home-made" devices for lightening the work of the men, and which devices are the product of Mr. Hawkins's fertile brain. In front of the upper part of the bench is fixed a rail, along which runs an arrangement, composed of wheels, pulleys, and chains, which enables the men to elevate scoops of coal, and transport them before any retort; and then, by means of a detachable roller carriage, which is expeditiously affixed to each mouthpiece as required, the retorts are charged by two men with remarkable celerity. The men exhibited to the visitors certain proof of the utility of the arrangement. Another simple device modifies the labour of drawing the retorts; and the usefulness of the appliances used in facilitating the feeding of the furnaces was also demonstrated. The cellar beneath the house is light and cool; and it is so arranged that it gets a refreshing current of air passing through, which makes the work of the men there far less fatiguing than it must be in some of the retort-houses it has been our lot to visit. On the works there are three holders, with a total storage accommodation for 250,000 cubic feet. The largest holder, which has been only recently constructed, has a capacity of 150,000 cubic feet. Mr. Hawkins has adopted the good idea of having all his holder valves in one building, in pairs; so that there is no excuse for a man closing one valve before he opens another. This gives an almost absolute insurance of safety. Four new purifiers, 18 ft. by 20 ft., have also lately been installed; and a 12-inch governor has been added to the works equipment. Formerly the works only possessed an 8-inch governor; but, with the new one, the district can be supplied in two different directions. A river runs through the town; and more pressure is required on one side than on the other. Consequently one side of the river is fed through the new governor; and the other through the old one.

After a thorough inspection of the plant had been made, the President very kindly entertained the members to luncheon in a marquee; and, the weather being fine and warm, the repast under such conditions was immensely enjoyed. Mrs. Hawkins, Mrs. and Miss Barton, and other ladies very gracefully attended to the wants of the President's visitors. Subsequently the party was grouped, and photographic records taken of the visit.

The Business Meeting.

From the works, the members walked to the Council Chamber, where the business portion of the day's programme was taken in hand.

Mr. H. Wimhurst (Sleaford), the retiring President, occupied the chair at the commencement of the proceedings, which he opened by remarking that the Chairman of the District Council (Mr. Birch) was present, and would offer a word of welcome.

Mr. Birch said it was with very great pleasure that he welcomed the members to the town. It was the first time they had been honoured by the Association meeting in Spalding; and he believed the town was very highly flattered in having the President residing in the town. Mr. Hawkins took a deep interest in producing gas of a superfine character; and they were very proud to have such a Manager as him conducting their works. He was sure they had made, as the members had seen, great progress at the works since they had the honour of having Mr. Hawkins as their Manager; and he believed the gas engineers present would fall in with the view that they had works which, for the size of Spalding, were equalled by none. He reiterated the pleasure it gave him to welcome the Association.

Mr. Wimhurst thanked Mr. Birch for his exceedingly kind remarks.

Minutes of the Last Meeting.

The Hon. Secretary (Mr. J. H. Troughton, of Newmarket) read the minutes of the meeting held at Cambridge on April 18 last; and they were confirmed.

Additions to the Roll.

On the proposition of Mr. J. T. Jolliffe (Ipswich), seconded by Mr. John Barton (Peterborough), Mr. C. J. P. Wadman-Smith, of Brigg, and Mr. J. Croxall, of Witham, were elected members.

The New President.

Mr. Wimhurst said his next duty was to vacate the chair in favour of Mr. J. G. Hawkins. No words in the way of introduction were required, as all the members knew Mr. Hawkins so well. He (Mr. Wimhurst) was sure he would conduct the affairs of the Association with satisfaction to the members, and with credit to himself.

Mr. Hawkins was installed in the chair amid much applause; and, having thanked the members for their hearty greeting, he at once delivered his

Inaugural Address.

Gentlemen,—My first duty in addressing this meeting is to express my grateful appreciation of the high honour you have done me in electing me as your President for the present year, and for the compliment bestowed in selecting Spalding as your place of meeting. In occupying the chair to-day, I feel I can rely upon the same kindly help and support of the members present that has characterized all our meetings in the past. The annual report of the Association will, I believe, be considered as highly satisfactory. The receipts during the year are fully equal to the expenditure; while the list of members continues to increase. During the past year, several well known and very highly respected members of the Gas Institute have gone over to the great majority, whose loss we all regret.

It is not my intention to weary you with a long address, especially as there is a considerable amount of business to come before the meeting that will require your attention; neither is there any need for it, seeing how well our technical journals perform their part in publishing all matters interesting to our profession. I have therefore selected a few subjects only on which I might offer some observations.

The published parliamentary returns just issued show an enormous increase in the consumption of gas for the past year, notwithstanding the continued demand there is for electric light. It seems remarkable, but it is nevertheless a fact, that the installation of electric light in towns invariably results in a larger increase than usual in the consumption of gas in those places. This may be accounted for in several ways—chiefly because of cooking and heating by gas, motive power, incandescent lighting, and the ever-growing desire there is for more light. The electric light, therefore, though a powerful competitor, is by no means an enemy; both forms of light may go on in friendly competition with each other and prosper. One thing I might mention, however, is that at present the percentage of increase in the consumption of gas is far greater than it is with the electric light. How long this will continue time alone can tell.

The march of improvement in the method of carbonization has grown apace during recent times. Regenerator and semi-regenerator settings have now almost entirely superseded the old form of direct-fired ones. Inclined settings have, in many instances, taken the place of horizontals; and a number of other minor improvements might be mentioned, all aiming at the same end—that of cheapening the cost of production. It is only a very short time since when anything from 9000 to 9500 cubic feet of gas per ton of coal was considered an excellent result, and very few aimed at anything above that. But now, with the improvements I have named, we are accustomed to obtain 10,000 to 11,000 cubic feet per ton—indeed, we sometimes hear of even better results than these being obtained. Anyway, the retort-house is undoubtedly the place which settles the question of profit and loss.

Carburetted water gas seems to have suffered a slight check lately, owing, no doubt, partly to the increased value of coke, and partly (though, I think I may say, chiefly) to the increased price of oil. That it will soon recover from this check nothing can, I think, be more certain; and that in the near future it will be used more largely than ever—mixed, of course, with coal gas. It has several features that commend themselves to our notice, such as the short time it takes to get the process in full work, and when in full work the great rapidity with which the gas is produced; also the small amount of labour it takes to work the process, all of which are matters of the highest importance in times of sudden fog, or from some cause or other when the production is less than the consumption, and the stock getting uncomfortably low. Again, it commends itself because of the great saving of hard laborious work compared with that in the manufacture of coal gas. The actual cost of production of both gases is practically the same, so there is nothing to choose on that head.

The introduction of stoking machinery has made rapid progress the last few years. How to save labour, or to make the work more pleasing to the workman, has for some time past been receiving considerable attention. The arduous work of the stokers, and the great heat under which they labour, is far from satisfactory; and whatever appliances are introduced that will render this work easier, will be welcomed with satisfaction both by employers and employed. So much progress has been made lately in this direction, that suitable machinery is now available for works of all sizes—from the very smallest to the largest—so that there is no reason now why shovel charging

should not be a thing of the past. A simple, yet very efficient, form of stoking machinery for medium-sized works was recently introduced at the gas-works here in Spalding; and those of you who have not already seen it, are invited to do so. It has been in operation about three months; and I am glad to say that it has greatly exceeded my expectations. The work is done quicker and better, and the stokers are relieved of a lot of heavy monotonous labour, as compared with charging with the shovel. The system is very popular with the men; and as an example of what they can do with it, I may say that two men will draw and charge seven oval ⌂ retorts, 10 feet long, 3¼ cwt. charges, wheel out and quench the coke, and do all else belonging to the draw in 20 minutes—being an average of less than 3 minutes per retort, or about one-third of the time it takes to do it with the shovel.

In addition to stoking machinery, many other forms of labour-saving appliances have been brought out—notably the coal conveyor, for conveying the coal from railway truck or barge into the stores; also machinery for conveying the hot coke from the retorts to the coke-yard, quenching it on the way, screening it, and, when necessary, loading it into trucks or carts, all without being once touched by hand labour. The saving effected by these two improvements alone amounts to at least 5d. per 1000 cubic feet as wages now go, besides the work being done more easily and better in every way.

The continued progress shown by the prepayment-meter system is astounding. In some towns it now forms almost one-fourth of the total consumption—especially where extra facilities are afforded as regard free fitting and stoves, &c. The rule adopted in Spalding, and which I find answers very well, is: On receipt of an application for a supply of gas, an inspection of the premises is made, and if satisfactory, gas is laid on, and two lights and a kettle-stove fixed free; the whole to remain the property of the Gas Department. The quantity of gas we supply is 22 cubic feet for a penny, with one penny in every six pence returned as discount each time the box is cleared, which makes it actually 26·4 cubic feet for one penny net, or at the rate of 3s. 2d. per 1000 cubic feet; as against 2s. 6d. charged to ordinary consumers. The difference of 8d. per 1000 cubic feet is, I find, about the right amount required to cover the cost of fittings, meter-rent, and the extra trouble of collection. I may say that the reason why we allow this class of consumers discount is because, since the system was first introduced, the price of gas has been reduced; and rather than be at the trouble and expense of altering the dial of the meters, it was decided to allow a discount instead, which is found to answer exceedingly well—indeed, it is liked by the consumers, as they enjoy having something to be going on with each time the meter is emptied. Taken as a whole, I consider these consumers fairly profitable and well worth the outlay incurred. The system brings us in touch with an entirely new class of consumers, who, in many cases, are unable to bear the cost of fittings and perhaps pay a deposit in addition, and then at the quarter-day have to reckon up with that dreadful man the gas collector.

The present high price of coal is the most serious question with us just now. In some cases, prices have doubled within the past four years; the result being that in most towns the price of gas has had to be raised. In considering the extra price we are now paying, credit, I think, should be given to the colliery owner for what he undersold the coal in years gone by. This is only fair; but the extra price now charged is, of course, very much greater than this. It is a most difficult question, and one that supply and demand alone can settle; and in the meantime, we must try and meet the difficulty as best we can. These exceedingly high prices cannot last much longer, for stocks are increasing everywhere, and buyers are being flooded out with it, and are at a loss to know what to do with the coal or where to put it; showing clearly that the supply is now quite equal to, if not in excess of, the demand. Iron has also dropped 10s. per ton already; and coal is certain to follow suit. Had all of us held off a short time ago from making contracts, and bought lightly as required, prices to-day would very likely have been lower than they are. Those who have not yet contracted have, I think, the best of the deal.

It is pleasing to note that very excellent reports have resulted from the labours of the Sulphate of Ammonia Committee during the past year. So far as the experiments on growing oats at Woburn and Dalmeny have gone, everything at present points decidedly in favour of sulphate of ammonia as against nitrate of soda; the crops being heavier and of better quality with sulphate than with nitrate. This is very gratifying indeed to us; and let us hope that it will result in a much greater use of sulphate among our agriculturists in the future than there has been in the past.

The Workmen's Compensation Act has now been in operation sufficiently long to enable us to form some idea of its effect on employers of labour. That considerable alarm was felt at the time the Act was passed was only natural; but a very short experience of its working has been sufficient to prove that the results are not nearly so serious as were supposed. The risks appear to be so trifling that insurances can be effected for covering them at very little cost. The Act has proved a friend in disguise in our case at Spalding; for the amount we pay the Insurance Company is less than we paid formerly in cases of injury to workmen.

There are a few other matters I should like to have touched upon; but I fear I have already trespassed upon your time, and therefore I will conclude by again thanking you most cordially for giving me the opportunity of addressing you here to-day.

At its close, the address was well applauded.

Mr. R. Brown (Cambridge) then read the following paper on

THE WORKING OF INCLINED RETORTS AT CAMBRIDGE.

When asked by your Committee to contribute a paper on this subject, I felt somewhat diffident on the matter, as inclined retorts have been dealt with so fully in other Societies, that it is impossible for anyone but a genius to put forth anything that is quite original. But seeing that this important subject has not been before our Association, I consented to contribute a paper to form part of your "Transactions."

In 1897, it was imperative that some extra retort power should be immediately provided; and the question which exercised my mind was, "Should I advise a new retort-house on the present lines, or improve the plant in the existing houses?" The two retort-houses were originally constructed to make 1,200,000 cubic feet per day; and I found that, by substituting inclined retorts for horizontals, we should be able to make 1,900,000 cubic feet per day on the same ground space, and with a great reduction in the cost of labour—a no inconsiderable advantage in these days.

The horizontal retort-house to be converted to inclines was 27 feet high to the eaves. It was therefore necessary to raise the walls to the required height of 50 feet, as shown on the drawing. Fortunately, the buildings are of a substantial nature, and readily lend themselves to any extra weight which it is necessary to put upon them. On the completion of the alterations to the building, five horizontal settings were pulled down, and five benches of inclines were constructed on the same site, consisting of six oval ⌂ retorts in a setting, set at an angle of 32°. This has been found the most suitable angle for the repose of the coals, and is now generally adopted. The retorts have a uniform taper throughout; their cross section being 4 inches wider at the bottom than at the top.

The section of the retorts is 20 in. by 15 in. at the top, and 24 in. by 15 in. at the bottom; and the length is 20 feet. There has been a great diversity of opinion as to the proper length of the retorts; but there is no doubt that 20 feet is the right measurement. It is quite evident that anything less must diminish the amount of coal carbonized; and, further than this, the labour in charging is the same, whether the length is 15 or 20 feet.

The coal (which should be as dry as possible) is brought into the works in carts, and tipped into the coal-breaker, which has two sets of teeth. But one set is ample for all requirements, as it is a disadvantage to break the coal too fine. When using "nuts," no breaking is allowed; they being permitted to fall through a screen into the elevator boot. While on the subject of coal, I am of opinion, from experience, that nuts are the most suitable for inclines, which is another argument in favour of this system of carbonizing; nuts costing us from 3d. to 1s. per ton less than ordinary coal.

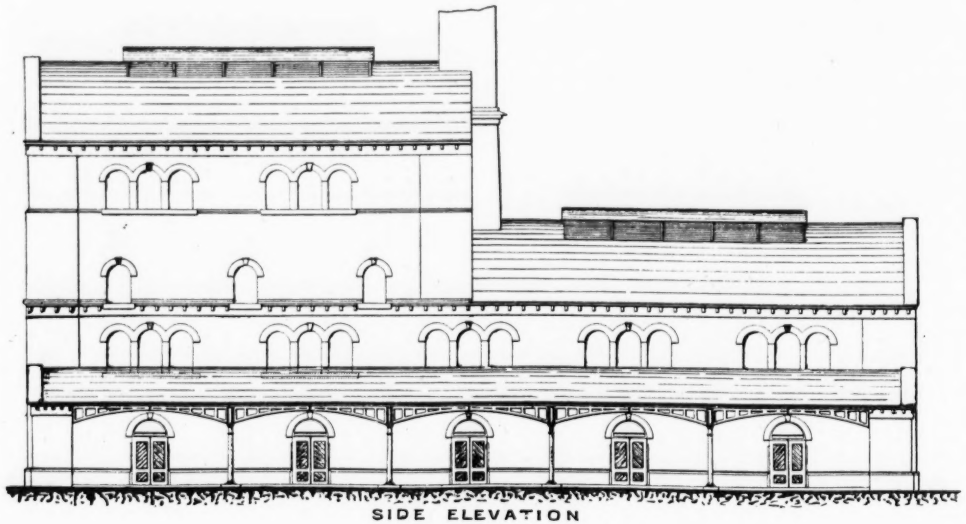
The coal is taken to the top of the house by an elevator of the chain type, and distributed in a continuous coal-hopper by a push-plate conveyor; the speed of the elevator and conveyor being about 90 feet per minute. About 45 tons of coal are dealt with each day; and the whole plant is worked by an 8-horse power steam-engine.

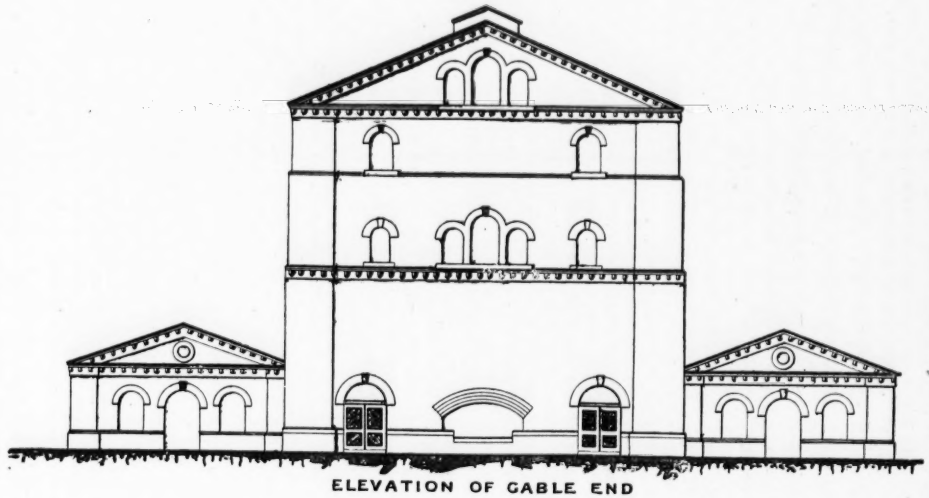
Underneath the coal-hoppers are fixed the measuring chambers; and here the charge can be altered to any amount from 7½ cwt., by means of a swing flap. Ours are set to give 7¼ cwt. of coal per six-hour charge. When the stoker pulls the lever in connection with the measuring chambers, the slide at the top closes, and the bottom one opens, allowing the coal to fall down into the charging shoot. This shoot has baffle-plates to prevent the coal from running down too fast. The stoker is also provided with a plate which he carries along the charging-stage, and places in the mouth of the retort. This provides a smooth surface for the coal to fall upon, and gives it a greater impetus. When the charge has run out, the stoker replaces the lever to its original position, which closes the bottom slide and opens the top one; the coal filling the measuring chamber from the hopper above, when the same process is repeated at the next charge.

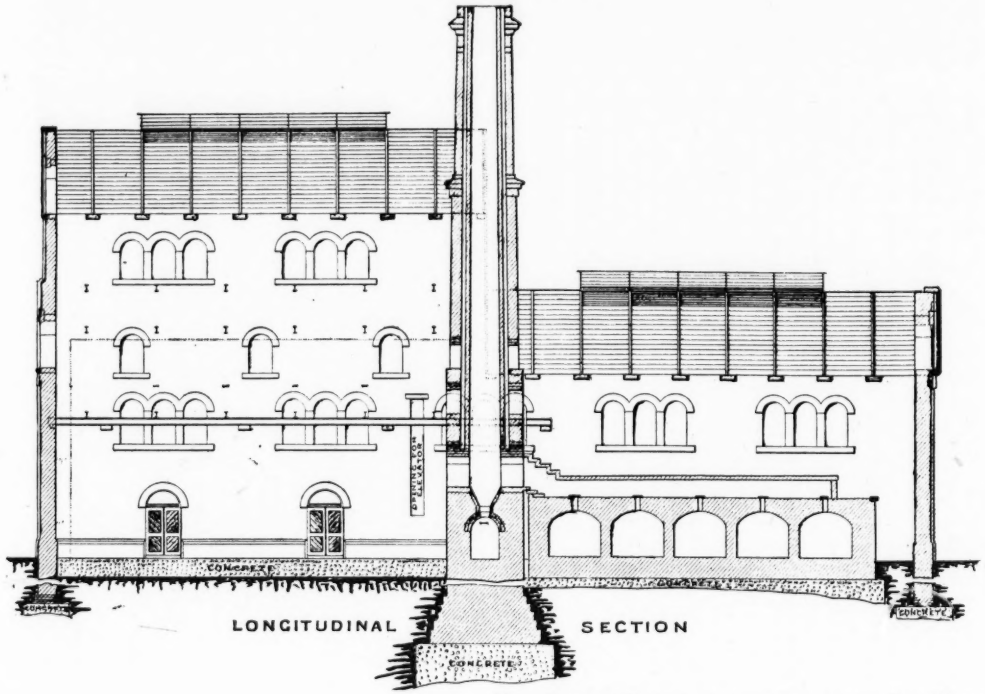
I am unable to give any information about what is known as the "creeping" of the charges, never having been troubled with the coals being too thick at the bottom end. The difficulty we had in the first instance was to get the coals to the bottom of the retorts. But we have now mastered this; and the charges lie perfectly even from top to bottom.

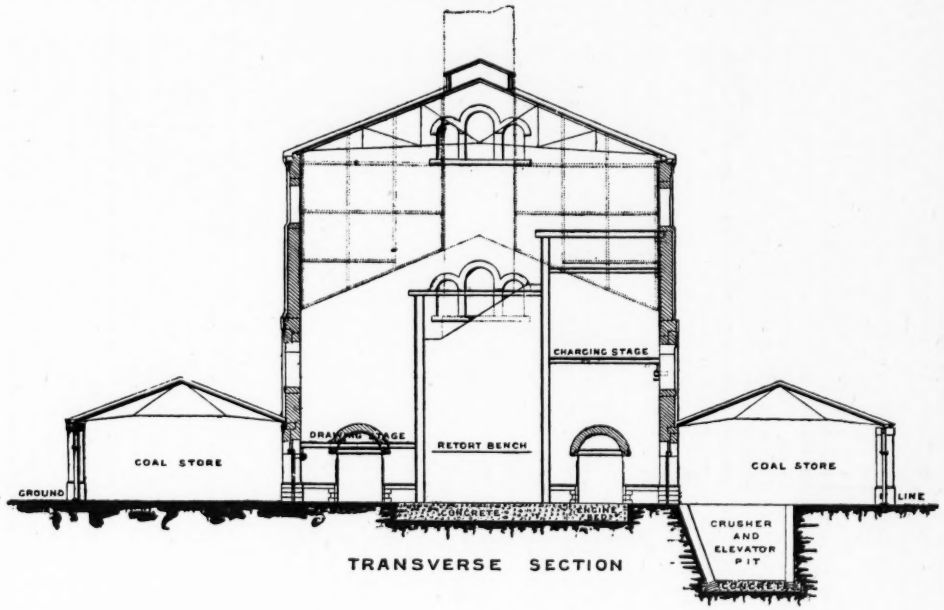
It is said that on opening the doors on the drawing-stage, and removing the stopper, the coke will fall out of its own accord. It does do so when the retorts are new, and the bottom surface perfectly smooth. But after they are worn, and get an uneven surface, the coke will require a certain amount of tickling; and the man on the charging-stage has to give it several pushes with a T-headed rake. It is a great mistake to claim for this system that it is perfectly automatic, both for charging and self-discharging; but the labour is infinitesimal compared with drawing horizontals.

The gas is all taken off at the bottom end, as it would be very inconvenient to have ascension-pipes and hydraulic mains on the charging side, owing to the charging apparatus. There

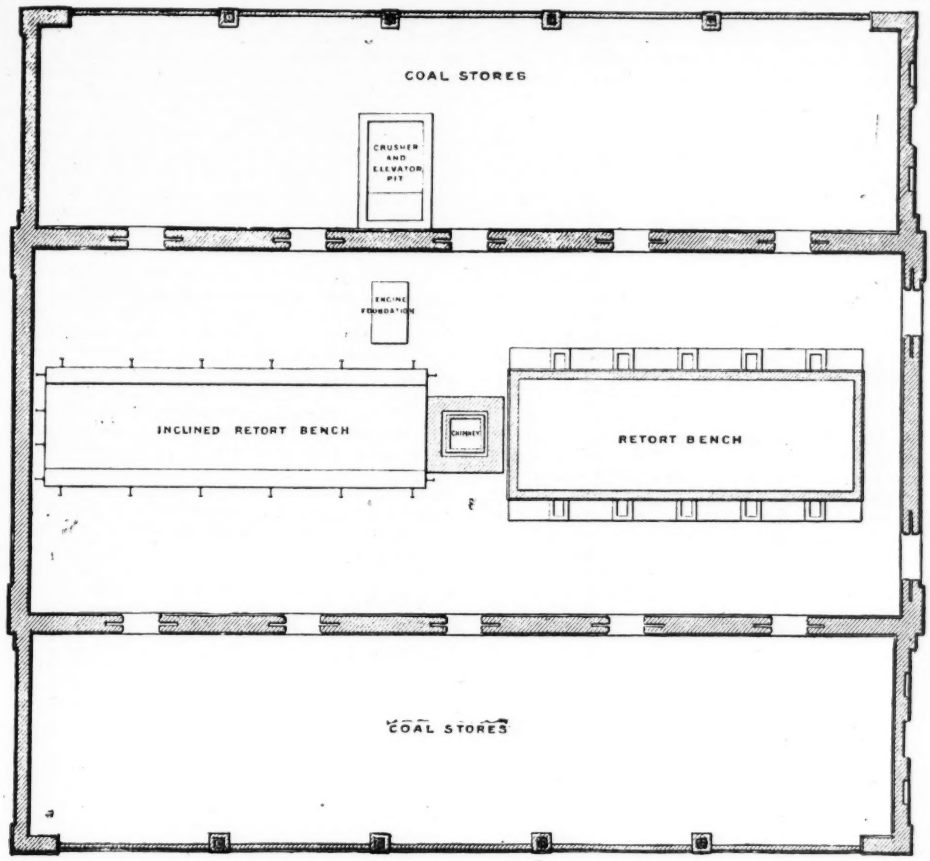








THE RETORT-HOUSE AT THE CAMBRIDGE GAS-WORKS, AS ALTERED FOR THE INCLINED RETORT SYSTEM.



PLAN OF THE RETORT-HOUSE AT THE CAMBRIDGE GAS-WORKS.

would also be a difficulty with stopped pipes, through the great heat rushing to the top. Taking the gas off at one end only has opened up a question as to the effect on the illuminating power of the gas having to travel over the hot coke. I have found there is no depreciation in illuminating value. The official tests for a month, when I was working inclines alone, averaged 16·44 candles, tested a mile from the works; and no enrichment of any sort was used. If we consider the passage of the gas in horizontals, this can be readily understood. Here it is supposed to traverse two ascension-pipes; but only one is working at a time, owing to the pressure first on one side and then on the other. Therefore the gas has to pass over the hot coke as much in horizontals as it does in inclines.

The retorts are worked with a light seal. Consequently the amount of carbon is small; and when scurfing is necessary, it is easily accomplished by leaving the top and bottom lids open. The current of air rushing up soon frees the carbon.

The great secret of success in working inclines is to have a properly constructed furnace. Ours are of the regenerative type, one producer to each set. They are easily manipulated; and the heat is regularly distributed throughout the settings. Some of the earlier failures were not due to the inclined retorts, but to the want of proper knowledge in the heating arrangements. The top end would get too hot, while at the bottom the coals were not properly carbonized.

The charging doors for the producers are on a level with the drawing-stage; the clinkering doors being on the ground level. The coke is discharged from the top retorts direct into the producers, by the aid of a portable shoot.

I do not admit that there is any falling off in the make of gas per ton of coal in working inclined retorts; but even if there was, the saving in the cost of labour would more than compensate for it. Owing to the mechanical means described, the men are enabled to do double the work with the same physical exertion.

The following is a statement showing the difference in the working of inclines and horizontals:—

Comparative Statement showing Cost of Working Five Sets of Inclines and Five Sets of Horizontals. Twenty-four Hours' Working.

INCLINED RETORTS.					HORIZONTAL RETORTS.				
8 stokers, at 5s.	each	2	0	0	12 stokers at 5s.	each	3	0	0
2 pipe jumpers, at 4s.	,,	0	8	0	2 pipe jumpers at 4s.	,,	0	8	0
2 foremen, at 6s.	,,	0	12	0	2 foremen at 6s.	,,	0	12	0
2 exhauster men, at 5s.	,,	0	10	0	2 exhauster men at 5s.	,,	0	10	0
		£3	10	0			£4	10	0
Coal carbonized per day, 45 tons. £3 10s. 0d. ÷ 45 tons = 1s. 6·66d. per ton of coal carbonized.					Coal carbonized per day, 32 tons. £4 10s. 0d. ÷ 32 tons = 2s. 9·75d. per ton of coal carbonized.				

Difference in favour of inclines, 1s. 3·09d. per ton.

Taking the working results for the last half year, the tota amount of gas made was 146,521,000 cubic feet, which cost to produce, in carbonizing wages, 2·48d. per 1000 cubic feet. Before the use of inclines, the average cost was 3·21d. per 1000 cubic feet; so if all the gas had had to be produced under the old conditions, the cost would have been £1959, instead of £1519, which was the actual figure paid—showing a saving in six months of £440. Surely these figures must convince anyone who has doubts as to the complete efficiency of the inclined system, that it is the right one, based as it is on gravity—one of the laws of Nature—and by the improvements made in the charging apparatus, whereby the coal can be checked in its fall from the measuring chambers, the chief difficulty has been surmounted.

After the stokers have overcome their usual prejudices to any improvement in the carbonizing plant apart from the shovel or the scoop, they are only too glad to be placed on the inclined work, where all heavy lifting of the coals into the retorts and drawing the coke by means of rakes is done away with. But it is not only the workmen who have been prejudiced in this direction; no radical change in a gas-works has received so much attention, and the true facts been so distorted, as in the case of inclined retorts.

Every little difficulty has been magnified from a mole-hill to a mountain; while any difficulties with horizontals are just passed over as quite ordinary occurrences, and nothing whatever is heard about them. That anyone working inclines will have small difficulties is certain; but all can be easily overcome by giving strict attention to minor details. Then the advantages I have placed before you can be easily obtained; and in these days of high prices of all materials in connection with our business, it is a duty that devolves upon us to decrease the cost of production to the lowest figure.

In conclusion, I cannot impress upon you too strongly that for medium-sized works—especially works which are not large enough to get full work out of expensive stoking machinery—a considerable saving can be made by introducing inclines, the most convenient and economical system of carbonizing of the present day.

Discussion.

The PRESIDENT said they were deeply indebted to Mr. Brown for his interesting paper. It was one they would have to read over in quiet moments, in order to digest the figures. He (the President) had seen several installations of inclined retorts, including the one at Cambridge; and he was very favourably impressed with the easy way the retorts were being worked there. He had no idea, however, until he saw Mr. Brown's installation, that they could be worked so simply. He had no doubt inclined retorts would be the carbonizing system of the future; but in small works the question of cost came in.

Mr. R. G. SHADBOLT (Grantham) thought that, as an Association, they were to be congratulated upon having the question of inclined retorts brought before them in such a clear and distinct manner. Mr. Brown had not elaborated too much. He had not wandered all over the subject; but he had given them very briefly and concisely the results of his own experience. On the other hand, Mr. Brown was also to be congratulated upon not having been troubled with what they had heard so much about in connection with the working of inclined retorts—that was, the creeping of the coal. In his (Mr. Shadbolt's) opinion, it must be a question more of coal than anything else; for they heard in some districts where these retorts had been tried that it was the greatest difficulty they had to contend with. Then they heard of them mixing one class of coal with another, and of various other remedies being tried—all with some amount of failure attaching to them. Mr. Brown, however, seemed happy in his choice of coal. Perhaps the size to which he broke it had something to do with it. At any rate, his experience was happier than that of many people who had tried the system. They often heard it stated that inclined retorts were applicable not only to large, but to medium and small sized works—more applicable than stoking machinery. He supposed by this was meant an expensive installation of power machinery. But the statement as to the applicability of the inclined-retort system would not apply to many of the works in the Eastern Counties. They might be called "medium-sized" works, and still come below the limit claimed for inclined retorts. There were not many of them, according to Mr. Brown's own showing, that could work inclined retorts. Consequently, they had to fall back upon the shovel, or some such improvements as they had seen that day at the Spalding Gas-Works. They had to apply information of the kind given in the paper to their own particular circumstances. Though inclined retorts might pay in works of the size of Mr. Brown's, he took it that in works much below that size they would not get much benefit. Mr. Brown had five arches of six retorts. This would be equal to, roughly speaking, a works of 160 million cubic feet per annum, supposing that was the entire carbonizing plant. Of course, in Mr. Brown's case, he had been using the inclined retorts altogether up to a certain stage, and had then fallen back upon the horizontal retorts to get up to his maximum make. If he had been working the five beds of inclines alone—that would be about equal to a works of 160 million cubic feet production—the figures would have been rendered more authentic. As it was, the two modes of carbonizing had been going on side by side.

Mr. BROWN: Quite so; but the figures given are for the inclined retorts working alone.

Mr. SHADBOLT: That is, for the entire bench?

Mr. BROWN: Yes.

Mr. SHADBOLT (continuing) said this brought him to the question of capital charges. Mr. Brown had given them a statement in his paper (and he took it the statement was absolutely correct) which showed a saving that was very striking—1s. 6d.* per ton of coal carbonized; and no gas manager who was looking out for methods whereby he could economize in the production of gas could afford to overlook a saving like that. But, in securing such a saving as this, one must expect to find some disadvantages; and one of them, it appeared to him (Mr. Shadbolt) came in in the increased capital charges. Mr. Brown had omitted all reference with respect to capital charges; but perhaps he had done this with the intention of drawing the members into a trap. (Laughter). At any rate, in connection with inclined retort installations where he (Mr. Shadbolt) had been able to get the cost, he had come to the conclusion that, generally speaking, the cost of inclined retorts was about double that of horizontal retorts, with regenerative settings and shovel charging. Taking this imaginary works, producing 160 million cubic feet of gas (which Mr. Brown's five beds of retorts would be equal to), it would be found that something like from 2¼d. to 3d. per ton of coal for capital charges would have to be taken off the saving—that was to say, they had a matter of £3000 to £3500 more capital expenditure upon the bench than they would have with ordinary hand-charged horizontal retorts and regenerative settings. Dividing the interest of (say) 5 per cent. upon this £3000 or £3500 by the coal carbonized, it would be found that it ran out to something like 2¼d. or 3d. per ton. This, then, was a disadvantage that must be taken off the savings. Again, in dealing with the items of cost, Mr. Brown showed the cost for stokers, foremen, pipe jumpers, and exhauster men. But he had also mentioned that he carted the coal into the works; and the coal had somehow or other to be broken and elevated into position for charging. The author told them that he was following a natural law in throwing the coal into the inclined retorts in this way. There was, of course, such a thing as the conservation of energy; but they must have a certain amount of energy for breaking and lifting the coal to the hoppers. This cost money; and besides there was generally a man set apart to see that the hoppers were kept full, and so on. This then was another disadvantage to be taken off the savings; and there might be other things. He had often wondered, too, how they managed the patching business with these 20 feet inclined retorts, set at an angle of 32°. They could not patch very well from the top; and if there was a hole near the top, it could not be reached very well from the bottom. This was a disadvantage. He had never yet heard what was the cost of ordinary repairs and renewals, compared with the horizontal system. He should imagine it would be greater. With inclined retorts, they were not only following the law of gravity, but that same law was everlastingly tugging at the retorts and settings to bring them to the ground; and this meant stress. These were a few of the items that should be deducted from the savings shown, though in bringing his paper before the Association Mr. Brown had espoused a very good cause. Inclined retorts seemed to be worked much better now than formerly. The difficulties appeared to have been overcome; and they had an example in the working of the inclined system at Cambridge which ought to satisfy the most fastidious. If anyone had been considering the advisability of adopting them, and if anything was keeping him back as to the reliability of actual working, then he had, in Mr. Brown's paper, all the information he required.

Mr. J. T. JOLLIFFE (Ipswich) regretted that he had had no experience with inclined retorts, although he must confess he had a great love for them. He wished his position had been similar to Mr. Brown's. If he (Mr. Jolliffe) could have adapted his retort-house to the inclined system as readily as Mr. Brown had been able to do, he should long ere this have gone in for inclined retorts. On the face of it, it appeared to him to be undoubtedly a step in the right direction. It was only a question of hoisting coal to the proper height; and the rest of the work was done by gravitation. The costs must necessarily follow in proportion, as Mr. Brown had so lucidly shown them in his paper. The question of capital charges was one that had to be considered very closely; but, with such a saving in so short a space of time, Mr. Brown clearly proved, to his mind, that capital interest and increased capital charges could be well and fairly made. The question of the creeping of the coal was the one that had given more trouble than any other; and, in this respect, Mr Brown had been very favourably situated. He (Mr. Jolliffe) saw that he had to deal, or could deal, almost exclusively with nut coal; and with such a coal as this, one would not expect there would be any creeping at all in the retorts. Mr. Brown also said that he got this coal cheaper; but if they all wanted nut coal, they would, instead of having it 3d. per ton cheaper, have it 1s. or so per ton dearer. He was glad to see that Mr. Brown tackled the little difficulties as they would all tackle them—they only arose to be overcome. He should like Mr. Brown to tell them the total cost of the alterations. He not only meant the cost of the inclined retorts themselves, but the total cost—such as the extra foundations, heightening of building, and everything incidental to the general installation. If the author would supply this information, it would be valuable to many of them.

Mr. W. D. CHILD (Romford) was pleased Mr. Brown had given the members an opportunity of becoming better acquainted with some of the costs of working with inclined retorts. He had had no experience with them; and he was therefore the more obliged to Mr. Brown or any other gentleman who placed before them the result of his own personal experience. It was for this reason that he should like to ask Mr. Brown if he would give them a little further explanation of the figures he had quoted in his paper. They showed on the cost of the stokers and other labourers, a total saving of 1s. 3d. per ton of coal carbonized. But the author afterwards gave them the total saving in the carbonizing wages for the year; and they hardly agreed with the figures previously given. Instead of coming out at 1s. 3d. per ton, he (Mr. Child) took it they would not amount to more than 8d. per ton. Perhaps, however, the difference would be covered by some of the other outlay that had been suggested by Mr. Shadbolt—such as the elevating of coal, and other things. What he meant was this, the author stated that before the use of inclines, the average cost was 3·21d. per 1000 cubic feet, and afterwards, with inclines, it was 2·48d. This gave them a difference of 0·73d.; and if they allowed Mr. Brown a make of 11,000 cubic feet of gas per ton, the difference was only 8d. per ton.

Mr. J. CARTER (Lincoln), invited by the President, said it seemed to him the ground had been pretty well covered. Their difficulty from the point of view of critics was that the paper was the result of experience. It was full of information; and therefore it did not seem to him, seeing it was a statement of results that had been actually obtained, there was very much any of them could criticize. Rather as a seeker for information, he should be glad if Mr. Brown could assure them that the saving, or apparent saving, of 3d. to 1s. a ton by buying nuts was an eventual saving—in other words, whether he could get the same results from nuts as from the best screened coal.

Mr. J. BARTON (Peterborough) asked whether the cost per 1000 cubic feet was per 1000 cubic feet made or sold.

Mr. BROWN: Made.

Mr. BARTON said he must say the cost was a very reasonable one.

Mr. BROWN, replying to the discussion, said Mr. Shadbolt had raised a question as to the size of works for which inclined retorts would be suitable. He (Mr. Brown) thought he should not go in for inclined retorts, with the necessary elevating and conveying plant, in works of less than 100 million cubic feet. Mr. Shadbolt took him to task somewhat about the question of capital; but, of course, he (Mr. Brown) had to leave him something to say, and so he gave him a little opportunity on this point. (Laughter.) But he might state that the raising of the

* Mr. Shadbolt asks us to say that quoting the saving on the inclined retorts as 1s. 6d. per ton, instead of 1s. 3d., was an oversight; but, as will be seen, it does not affect his subsequent argument.—ED. J.G.L.

retort-house had now been completed throughout; and the whole of the alterations to the house complete had cost £1260. The beds worked out at nearly £1100 each; but then they must take into consideration that there were heavy royalty charges which were now done away with. Mr. Shadbolt made one little slip in saying the saving was 1s. 6d. per ton. The only saving he (Mr. Brown) claimed was 1s. 3d. The 1s. 6d. was the cost of carbonizing; but the saving in favour of inclined retorts was 1s. 3d. per ton. Then Mr. Shadbolt went on to say that the cost of getting the coal to the elevator and above into the coal-hoppers had not been taken into consideration in giving the cost. He (Mr. Brown) did not think it was hardly necessary, because with horizontals the coal was shot down, and had to be wheeled into the retort-house. Therefore, if he gave the cost of putting the coal into the elevator, and the cost of wheeling the coal for the horizontals, he thought he could claim a little more than he had already done. Then Mr. Shadbolt spoke about the patching of retorts. There was nothing more difficult in patching inclines than horizontals. It was perhaps a little awkward until the men got used to it; but by the aid of a moveable platform on the charging-stage the retorts were quite as easily patched as horizontals. With regard to the wear and tear of the retorts, there was no wear and tear owing to the coal going down. If they took into consideration that with horizontal retorts they had not only the coal going in and out, but scoops and rakes passing in and out, whereas——

Mr. SHADBOLT: I was speaking of repairs and renewals as compared with horizontals. Not the internal wear.

Mr. BROWN (proceeding) said that the retorts were put to work in December, 1898; and, excepting for a brief period (for about a month they were let down for the purpose of re-lining the furnaces), they had been at work ever since, and likely to be for some little time. Mr. Jolliffe had asked about the total cost of the alterations. The total cost for the five beds alone was £6145. This included everything—house, elevator, plant, furnaces, retorts, and everything. He did not want to claim anything for this system that really it did not possess. He wished the members to understand this—that, when he first went to Cambridge, it was necessary to make some alterations; and it came to this, Should there be a large capital expenditure on a new retort-house, or should they do something to improve the working? It occurred to him that the best way would be to go in for inclines, and so decrease the cost of labour and so on without raising a lot of capital, because the original cost of the five beds of horizontals would then be charged against revenue account. In this way, they had decreased the capital expenditure, and increased the make on the ground formerly occupied. He could not give the total cost of the ten beds, simply because they had not gone in for the additional five beds at present; and he was not able to say what the next contract would be. Mr. Child spoke about the saving only working out to 8d. per ton. Very likely not; but Mr. Child must understand that the two systems were in operation the whole of the six months. Twelve or thirteen beds of horizontals had to be worked with the five beds of inclines to furnish sufficient gas. The figures given represented the total working of the two systems together for six months. As to Mr. Carter's question, he might say that from screened nuts he obtained quite as good results as from ordinary coal.

THE SPRING MEETING.

Mr. WIMHURST proposed that the next meeting be held in the city of Norwich. He explained that, during the past few years, the spring meetings had been held at Cambridge. But seeing that Mr. Brown would be their next President, and would like to read his Inaugural Address in his own town, it was thought advisable that the Association should depart from their usual course, and journey next spring to the eastern side of their division, so that the autumn meeting could be held at Cambridge.

Mr. JOLLIFFE seconded the motion, which was unanimously agreed to.

VOTES OF THANKS.

Mr. JOLLIFFE said he had been asked to propose a vote of thanks to the President for his address. He did so with very great pleasure. The Chairman of the District Council had been good enough to say how fortunate the people of Spalding were in having such an eminent gentleman as Mr. Hawkins to manage their gas undertaking; and he (Mr. Jolliffe) thought the Association were equally fortunate in having him for their President. The address, although not long, conveyed a great many points of interest. He was unfortunate in not having arrived in time to look over the works to see what Mr. Hawkins had done; but judging from what the Chairman of the District Council had said, Mr. Hawkins must have accomplished valuable work indeed. He should particularly have liked to have seen his method of charging retorts. He was in time, however, to partake of Mr. Hawkins's hospitality; and he believed the whole of the members felt they were greatly indebted to him for his thoughtfulness. He therefore proposed a vote of thanks to him both for his address and for the way he had entertained the members.

Mr. SHADBOLT, in seconding the motion, said there was something very happy in the arrangement that they should visit their President in his own town at the time he delivered his Inaugural Address, because then they had an opportunity of not only hearing what he had to say for himself, but of seeing what he had done for himself and for those for whom he laboured. If they considered the works in conjunction with the address, they got a better idea of the man, of his work, and of his town. Mr. Hawkins was a man whom they were proud to have as President. In the vote he thought they ought to include Mrs. Hawkins, Mrs. Barton, and the other ladies who had assisted in so hospitably entertaining them.

The motion was very cordially agreed to.

The PRESIDENT, in responding, said he was extremely obliged to the members for their vote. If he had done anything to contribute to their happiness at this meeting, he was amply repaid.

Mr. CHILD moved a vote of thanks to Mr. Brown for his paper. The paper and the plans would be very useful to any of them who were considering this subject in the future. Proposing this vote, enabled him to explain that he asked the question he did, with reference to the difference in the figures, as he felt sure Mr. Brown would be able to give a satisfactory explanation. It was only right he should have an opportunity of doing so before the paper reached others who might have fallen into the same error as he (Mr. Child) appeared to have done.

Mr. BARTON seconded the motion, which was heartily passed.

Mr. BROWN said it had been a pleasure to him to put before the members a few points of interest from his own experience with the inclined-retort system. If any member was going in for this system at any time, and required information, he should be only too glad to render him what assistance he could.

On the proposition of Mr. CARTER, seconded by Mr. WIMHURST, a hearty vote of thanks was accorded to the Chairman and the District Council for the kindness and courtesy they had shown to the Association.

Mr. G. HALL, responding for the District Council, remarked that they were honoured by the visit of the Association.

THE SCOTT-SNELL-PHILLIPS SELF-INTENSIFYING LAMP.

By the invitation of the Committee, Mr. C. W. Phillips (of the Scott-Snell-Phillips Syndicate) had on view a specimen of the self-intensifying lamp of which we gave an extended notice on the 14th ult. The lamp was the same one that was on view at the offices of the Paris Gas Company at the time of the International Gas Congress, and since at Bradford during the meeting of the British Association; but these considerable journeyings had evidently had no detrimental effect upon it.

The PRESIDENT called attention to the lamp, remarking that it was a highly powerful light. He suggested that Mr. Phillips should give the members an explanation as to its construction and mode of compressing the gas.

Mr. PHILLIPS complied, supplying a detailed description by the aid of three diagrams. He also pointed out that the lamp was self-intensifying, and contained no mechanism other than the one moving part in the head of the lamp. What was claimed for the lamp was that by it they could raise the ordinary gas pressure up to from 4 to 24 inches at will. Of course, they burnt rather more gas than would be consumed with an ordinary mantle giving about 60 candles; but still there was a vast economy when it was considered that they realized (say) an illuminating power of 300 to 350 candles from a single mantle. The principle of the lamp he explained as follows: (1) Pressure (4 inches to 20 inches of water) was obtained by the expansion of the gas in the lamp body due to heat. (2) The heat was obtained from the waste products of combustion. (3) Suction was caused by cooling the remnant of gas in the body after process No. 1. (4) Cold was obtained by a water jacket. (5) Pressure and suction heat and cold alternately followed as the displacer was raised or lowered. (The displacer, he incidentally remarked, was not a piston, and had not a pumping action.) (6) Motion necessary to reciprocate the displacer was obtained from the alternate pressure and vacuum in the body. These acted upon a diaphragm to which the displacer was made fast. In fact, the whole working was automatic, and more like the lungs of a human being than anything else one could imagine. The gas container arranged above the reflector had a capacity of (say) 80 cubic inches. It contained a displacer of (say) 30 cubic inches capacity. This left a space of 50 cubic inches always available for gas. This space remained constant whatever the position of the displacer might be. But if the displacer was raised to the upper part of the container, the gas was caused to assemble at the lower part. *Per contra*, if the displacer was lowered, the gas assembled at the upper part of the container. The lower part of the container was heated by the products of combustion; and the upper part was cooled by a water-head. It therefore followed that (1) if gas was assembled at the bottom or hot part of the container, it became heated and tended to expand, and (2) if gas was assembled at the top or cool part it became cooled and contracted. The vertical oscillation of the displacer therefore caused alternate pressure and vacuum (partial) to obtain. But when pressure obtained, some of the gas blew out through the outlet check-valve into the reservoir and fed the burner. When vacuum obtained, a similar quantity of gas was sucked in through the inlet check-valve. Such an action, continuously maintained, produced the equivalent to a pump; and thus the reservoir was kept charged with gas at any desirable pressure within reason, A definite pressure was obtained by simply operating the gas-tap so that the amount of gas drawn was limited. A governor would, of course, automatically control this in all regular installations. The

vertical reciprocation of the displacer was effected by attaching it to a diaphragm, which was responsive to the variation of pressure within the container. A spring was added to support the weight of the displacer. The range of action of the spring was limited so that, when the displacer was lifted by pressure on the diaphragm, the support of the spring gradually ceased, and the initial impulse or "kick" which set the displacer in motion being exhausted—that was to say, the momentum being lost—the displacer tended by gravity to fall back again upon the spring. The slightest movement in this backward direction must be followed by a complete fall, because a part of the expanded gas (that was, heated gas) was assembled at the cold upper part about the displacer and condensed; thus causing a further fall in pressure, and, by finally producing vacuum, causing the atmospheric pressure to be felt upon the diaphragm, and to drive it down. This very much depressed the supporting spring as long as vacuum obtained; but when fresh gas was sucked in, the atmospheric pressure on the diaphragm was counterbalanced, and the spring asserted its power, causing a rebound or lifting up of the displacer, and the cycle commenced once more. The outlet check-valve was slightly weighted, so that a certain amount of pressure should accumulate in the container, and press upon the diaphragm before it blew out into the reservoir. Among other points, Mr. Phillips mentioned that, in order to increase the efficiency of the lamps, they were corrugating the head to give extra radiating surface, and altering the shape so as to cool from the bottom side of the head. And, further, to obviate the shadows thrown by the gas-pipes in the first pattern of lamp, they were now leading the gas by pipes embedded in the stays of the lantern. Every part of the lamp was also being made interchangeable.

The PRESIDENT having invited criticism or questions by the members as to the lamp,

Mr. JOLLIFFE said he had been deeply interested in the intensified system of gas lighting; but the drawback hitherto had been the need of convenient means of some sort for increasing the pressure. Although they, as gas engineers, might perhaps by-and-bye deliver their gas at a considerably higher pressure than they did now (he hoped they would), yet this lamp struck him as being a very valuable invention, and one, indeed, that was likely to be of great interest and service to the gas industry. He did not know if any of the members had been to Paris, and seen the splendid installation of intensified gas lighting in the Champ de Mars; but really and truly there was no electric lighting in Paris to compare with it in the slightest degree. This lamp seemed to him to give them a way out of the difficulty of introducing an auxiliary motor. He should like to know the material of which the diaphragm was constructed at the top, and also as to the continuous length of time that one of the lamps had been in use. He asked this question because it struck him, on the face of it, that the chamber at the top which was filled with water would gradually get heated, and would do away with the pretty system that caused the increase of pressure.

The PRESIDENT remarked that there was one little point that occurred to him, and that was as to replenishing the water. Would the water be likely to evaporate quickly, or was it condensed and thrown back again?

Mr. PHILLIPS: Yes, Sir. Replenishing about once a year will be found quite sufficient.

Mr. BARTON asked what effect a severe frost would have on the top chamber?

Mr. PHILLIPS replied that they only used the water for cooling; and, in answer to Mr. Best, he said they did not mind if the water did freeze.

Mr. BARTON: So long as the chamber containing it does not burst?

Mr. PHILLIPS: Exactly.

Mr. WIMHURST: The lamp is made of copper?

Mr. PHILLIPS said it was. He might explain that the water had no other function than the cooling of the gas; and the cooler they could keep it, the better pleased they were. As a matter of fact, heat was their great enemy.

The PRESIDENT: Does the displacer work up and down in the water?

Mr. PHILLIPS said it did not. The water was in a chamber round the head of the lamp, and nothing touched it. He understood Mr. Jolliffe to ask how long they had the lamp running continuously. In the "JOURNAL OF GAS LIGHTING" for Aug. 14 would be found a diagram showing the results of a twelve-hours' continuous run. At the end of that time, the maximum water temperature was only 184°, although, for a great part of the time, the gas pressure had been 22 inches. So far as the diaphragm was concerned, the one in this lamp was made of a material supplied by Messrs. Cowan, who informed them that it had a life of twenty years in their meters. He believed it was manufactured of some special skin. Various suggestions had been made as to this diaphragm. Some would like it to be of metal, and others preferred the material that Messrs. Cowan supplied.

Mr. E. W. SMITH (Chelmsford) inquired whether the lamp had stood the test of a winter. Although Mr. Phillips assured them that it did not matter whether the water froze in the chamber, still it seemed to him (Mr. Smith) that, unless there was another means of supplying gas to the burner, they might some evening, after a severe day's frost, find the small valve stuck fast, and the moisture which had condensed in the tubes frozen solid.

Mr. PHILLIPS: There is no connection between the valves and the water.

Mr. SMITH: But the gas passes round through the valves. Do you keep a small bye-pass jet burning? Perhaps it is not proposed to do so?

Mr. PHILLIPS: No. Of course, it would be easy enough to put something in the water to prevent freezing.

Mr. SMITH also inquired whether Mr. Phillips could tell them the cost of the lamp on view. It was really a very interesting invention.

Mr. CHILD asked whether the amount of pressure at which it was wished to consume the gas could be determined, or whether it would vary—say, at one time 6 inches pressure, and at another 20 inches? Or could they have a constant increased pressure such as they might desire to use the gas at?

Mr. PHILLIPS said, as far as he knew, there was nothing abnormal about this lamp that would in any way affect the valves, or the action of the gas on the valves, in cold weather. They had not yet had a lamp running during the winter. As to the cost, obviously, if the top to the lantern was merely a matter of metal stamping, the manufacture would not cost very much; and then there would be their own profit on the sale. As from one mantle, an illuminating power of something between 300 and 400 candles could be obtained, he thought they could get a fair profit on their lamps, and at the same time do a good deal for the people who purchased them. Regarding the pressure, it was quite easy to govern it. It could be governed to 8, 9, 10, or 12 inches, or to any pressure within reason. Moreover, if it was desired (say) at midnight to cut down the quantity of light, simple means were provided for putting the arrangement out of action, and obtaining the ordinary 60-candle power light.

The PRESIDENT thanked Mr. Phillips for his kindness in bringing the lamp to the meeting, and for the interesting explanation he had given the members.

An acknowledgment by Mr. Phillips ended the technical portion of the day's proceedings.

A PLEASANT CONCLUSION.

The interval between the meeting and the dinner was whiled away by the members paying a visit to Ayscoughfee Hall and Gardens, which are celebrated for their magnificent yew trees. Dinner was served at the White Hart Hotel, and about fifty members and friends sat down. The President occupied the chair; and the vice-chairs were filled by Messrs. Brown, Carter, and Troughton. The Chairman and other members of the Local Authority honoured the Association by their presence. Mine host provided a dinner which sustained the reputation of his house, and this and the festive spirit which reigned led to one and all deriving the maximum enjoyment out of this little relaxation from business affairs. The usual toast-list was duly passed through.

POWER GENERATION BY STEAM-ENGINE, WATER TURBINE, AND GAS-ENGINE.

Before the Mechanical Science Section—in future to be called the Engineering Section—of the British Association, at the recent Bradford meeting, a paper on the above subject was read by Mr. John B. C. Kershaw, F.I.C. We have no space to reproduce in the "JOURNAL" the full text of the paper; but the portion relating to gas-engines, and the conclusions arrived at by the author, merit publication in our pages.

The author pointed out that there is no question of greater importance at the present moment to those engaged in the management of our manufacturing industries than that of power generation. The supremacy which the steam-engine has so long enjoyed is now assailed from two sides. The water turbine and the gas-engine have become dangerous rivals; and there are those who assert that early in the twentieth century we may expect to find the steam-engine ousted from its place as the most economical prime mover by one or other of these later forms of power generators.

During the past ten years, a most remarkable development of hydraulic power has been taking place on the continent of Europe and in America. The large power installations in the Haute-Savoie, in France, in Rheinfelden, in Germany, and at Niagara, in America, have already become of considerable industrial importance. The success which has attended these earlier installations of turbines and dynamos, operated by water power, has led to the exploitation of numberless schemes of a similar character. The aggregate amount of power at the present date, generated from falling water, forms no inconsiderable portion of the total power utilized in manufacturing industries; and two years ago it was estimated by the writer to be between 236,000 and 350,000 horse power.

On the other hand, gas engineers have been busily engaged in working out the problems presented by large gas-engines, and by the utilization of the waste gases of blast-furnaces. Trials which have been made during recent years show that both of these problems are capable of successful solution. Gas-engines up to 650-horse power have been built and have worked smoothly and economically; while at Seraing, in Belgium, and at other

places the blast-furnace gases have been utilized for driving the engines which supply the blast.

The question, therefore, which the engineer now has to settle, when deciding upon the site and locality for a new factory, or when deciding upon the system of power generation to adopt for extensions of the old, is no longer so simple as when only one method of power generation in large units was open to him. It is no doubt true that the choice between the three possible sources of power is one which in many cases will be settled purely by local considerations; and the proximity of a large waterfall, or of an extensive coal-field, to the factory, will be held to point to the turbine, or to the steam-engine, as the most economical power generator. In a great number of cases, however, especially when the decision of the engineer covers the choice of a site for the factory, the problem is capable of no such easy solution; and the most economical source of power can only be determined after an exhaustive study of comparative costs data.

The third section of the paper (that which deal with "Gas Power") was as follows:—

1. By the use of gas-engines and Mond's latest form of producer, 23·8 per cent. of the energy of bituminous coal can be converted into mechanical energy. The actual figures for a 25-horse power Crossley gas-engine are 2166-horse-power hours per ton of fuel.—("Proceedings of the Institution of Civil Engineers," March, 1897.)

2. Statement by Dr. Bowman that with gas-engines of the best type, 1 lb. of coal yields 1-horse-power-hour. With a 300-horse-power plant the horse-power-year (apparently of 2825 hours) costs only 30s. The capital outlay per horse-power for producers and engines is £12, or 20 per cent. higher than with a modern steam plant; but the thermal efficiency is 50 per cent. greater.—("Journal of the Society of Chemical Industry," December, 1897.)

3. At Lausanne, in Switzerland, a 390-horse power gas-engine plant has run satisfactorily for over two years for the supply of the electric power to the tramway system. The plant consists of three 130-horse power Crossley engines, working with an expenditure of 1137 lbs. of coal per horse-power-hour.—("Electrical Review," Nov. 11, 1898.)

4. Statement by Dowson that at Halifax the consumption of fuel is 1·01 lb. per horse-power-hour.—("Mechanical Engineer," 1898, p. 703.)

5. Statement that by the Thwaite-Gardner system of utilizing the waste gases of blast-furnaces, 1 indicated horse power is obtained per 1·3 lbs. of coke charged into the furnace.—("Electrical Review," Dec. 30, 1898.)

6. Results of trials of the above system at the Wishaw Iron Works, Glasgow; 10-horse power can be obtained per ton of fuel charged into the furnaces per week (6 × 24 hours).—("Electrical Review," May 6, 1898.)

7. Results of tests by Professor Meyer of 60-horse power gas-engine at Differdingen, run on blast-furnace gases. The thermal efficiency varied between 27·4 and 30·2 per cent.—(Abstracted, "Engineering Magazine," July, 1899)

8. A 1500-horse power Westinghouse gas-engine, now building, is expected to develop a thermal efficiency of 30 per cent., or 1 brake-horse-power per pound of coal charged into the producer.—("Electrical Review," July 28, 1899.)

9. At Northwich, a 300-horse power gas-engine has been running on producer gas for a considerable period, and yielding 1 brake-horse-power per pound of coal charged.—("Journal of the Society of Chemical Industry," July, 1899.)

10. Meyer has estimated that in Germany, using blast-furnace gases, the horse-power-hour could be generated at a cost of 0·699 pfg.—("Revue Universelle des Mines," July, 1899.)

11. Lencauchez has estimated that using producer gas generated from French anthracite coal, 1-horse power hour would cost 0·0163 fr.—("Journal de Société des Ingenieurs de France," 1899.)

12. Estimate by Humphreys of the cost of an electrical horse-power hour, using Mond producer gas, based upon a plant of 10,000-horse power = 7000 electrical horse power. Capital expenditure estimated to be £140,000, and total running expenses, £35,000. Interest taken at 8 per cent.—"Proceedings of the Institution of Civil Engineers," March, 1897.)

Converting these data into comparable form, and gathering the results together, we have the figures presented in the following tables:—

Fuel Consumption of Gas-Engine Plants.

Place.	Pounds of Fuel per Horse-Power Hour.	Authority.	Reference No.
Pittsburg	1·00	Westinghouse Engineers	8
	1·00	Dr. Bowman	2
Northwich	1·00	Beilby	9
Halifax	1·01	Dowson	4
	1·03	Humphreys	1
Lausanne	1·137		3
	1·300*	Thwaite	5
Glasgow	1·555*	Booth	6

* These refer to coke and blast-furnace gases.

Estimated Costs of the Electrical Horse-Power-Year of 8760 Hours when Generated by Gas Power.

Authority.	Cost.	Remarks.	Reference No.
	£ s. d.		
Meyer	4 1 7	Blast-furnace gases	10
Humphreys	5 0 0	Mond producer gas	12
Bowman	6 2 0	Ditto	2
Lencauchez	7 12 2	French anthracite used in gas producer	11

Conclusion.

Taking the best figures for each of the three sources of power dealt with, and bringing them all to a common basis of comparison (namely, the cost of the electrical horse-power-year of 8760 hours), we obtain the following figures:—

Comparative Costs of Electrical Power. Lowest Recorded Costs per Electrical Horse-Power-Year of 8760 Hours.

Source of Power.	Lowest Estimated Cost.	Country.	Lowest Actual Cost.	Country.
	£ s. d.		£ s. d.	
Water	1 5 5	Canada	1 19 0	Switzerland
Steam	4 18 8	England	4 17 7	United States
Gas (blast-furnace)	4 1 7	Germany		
Gas (producer)	5 0 0	England		

The figures support the opinion now generally held, that water, when developed without excessive capital expenditure, is the cheapest source of mechanical or electrical energy. When, however, the hydraulic engineering expenditure has been heavy, or when the power after generation has required to be transmitted over long distances, the margin between the relative costs of water and steam power is greatly narrowed, and in some cases disappears altogether.

Turning to a consideration of the relative position of gas power, the question of the practicability of large engines may be taken as settled; but until further experience has been gained with these large engines under constant work, it is unsafe to prophesy upon the place they will occupy in the future industrial development of this and other countries.

If they do not cost excessive sums for maintenance and repairs, large gas-engines—in conjunction with coke-ovens and blast-furnaces—may entirely alter the present position of affairs; and new industries which at present are being established in the neighbourhood of water-power stations, may find themselves in severe competition with similar manufactures carried on in the coal and iron districts of the older manufacturing countries.

It has been calculated that 2,000,000-horse power is annually wasted in the gases issuing from the blast-furnaces of the United Kingdom. If these waste gases could be industrially utilized in the manner suggested, we should to a large extent be compensated for our lack of natural water power. But blast-furnaces demand coke, and coal beds are exhaustible; so that "even if this source of mechanical and electrical energy be tapped, it can only postpone, but not avert, the final triumph of the waterfall and of the turbine."

The Calcium Carbide Industry in the United States.—This is said to be controlled by the Union Carbide Company, which operates two plants—the larger at Niagara Falls, the other at Marie, Michigan. In Canada, two plants are also in operation—one at St. Catherine, and a new one at Ottawa. The output at Niagara for 1898 was from 8 to 10 tons a day, using 2500 electrical horse-power. In 1899 the yield was increased to from 20 to 30 tons a day, with the use of 5000 electrical horse-power. The present production of the Union Carbide Company is about 1000 tons a month. The continuous Horrey furnaces are in operation in the two plants; and the present price of carbide is £14 a ton. The carbide is guaranteed to yield 5 cubic feet of acetylene per pound. At St. Catherine, Canada, with the use of 1200 electrical horse-power, the output is 1200 tons of carbide per year. At both Ottawa and St. Catherine the Willson pot-furnace is employed. The export price is £12 per ton, in cartload lots.

The Lighting of Next Year's Glasgow International Exhibition.—Our advertisement pages the last few weeks have contained an intimation that the Executive Council of the Glasgow Exhibition, 1901, were wishful to receive proposals for exhibits of incandescent and other systems of novel gas lighting for illuminating the grounds and detached buildings of the exhibition; it being stated that for such exhibits gas would be supplied free of charge. It is to be regretted that this offer has not been more generally accepted by firms in this particular line of business. As a matter of fact, up to a few days since no proposals had been made to the exhibition authorities by any firms who supply high-power burners. In view of the splendid show in Paris, this is most unfortunate; but possibly these remarks may lead to dealers in high-power gas-burners at all events making the necessary preliminary inquiries, so as to see what they are able to do, not only to help forward their own business, but also to render more attractive what promises to be a most successful exhibition in other respects. It is certainly to be hoped that the largest portion of the grounds will be illuminated by gas.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Why Should Not Gas Companies Mine Their Own Coal?

Sir,—A question has been recently discussed by more than one local authority owning their own gas-works (though, so far as I am aware, without leading to any definite result, or the formulating of any plan), which has probably suggested itself of late to many concerned in the gas industry—namely, whether it might not be practicable, and, further, be sound policy, for some at any rate of the largest of the gas undertakings in this country, or a combination of the smaller companies, to acquire and work collieries for the production of their requirements of coal. The *primâ facie* advantage to those undertakings of purchasing at a reasonable figure—for it is not, of course, suggested that the present is the time at which the acquirement should take place—a property containing sufficient coal to provide for the whole, or greater part, of the consumption at the works for, say, fifty years to come, thereby making it independent of the state of the general coal market (except in so far as the rates of wages to the miners fluctuated in sympathy with those paid throughout the trade), need not be enlarged upon to gas managers in this present year of grace. Would Mr. Livesey have had to raise his price 7d. this year, if last winter he had had sole control of the right to the output of the Seaham Collieries?

It is, it seems to me, a suggestion that at least merits consideration by the heads of the industry, who will have, it is true, plenty of time to discuss the question before coal falls to a price at which it would be policy to buy up any mines. The policy would not be absolutely novel—it is, indeed, only an extension of the plan of growing one's own potatoes, not, it must be admitted, always a profitable speculation—for it has been largely adopted by the ironmasters, in this and other countries. And it is these very companies who own collieries that at present stand on firm ground, while others feel their foundations shake. Ironmasters also, in many instances, acquire their own iron-ore mines. The great firm of Carnegie may be said to be the leading case in point. In order for the transaction to be sound economy, it would, of course, be necessary for a company to buy, upon expert advice, at a price which would ensure that the average cost of production, *plus* interest on capital and a charge for sinking fund (to provide against the day when the seams should be exhausted), should equal, or not considerably exceed, the average price of coal for the past ten or twelve years. Should the cost to the gas company slightly exceed that average, the advantages arising from uniformity of price might, and probably would be found to, more than compensate for such small excess.

The consent of Parliament would, of course, be required; and it is a very open question whether it could be obtained. The refusal of powers to manufacture—in distinction from supplying—gas fittings, stoves, &c., may be held to point to a probable rejection of proposals to acquire and work collieries. But if, as I take it, Parliament's objection to gas undertakings manufacturing fittings, &c., for sale be based on the ground that such manufacture would be in the nature of unfair competition with ordinary traders in such goods, a different view might be taken of the proposal to buy and work coal mines, as the latter proceeding would not be for the purpose of competing with other coal merchants for any custom but one's own. A difficulty might arise as to the disposal of coal unsuited for gas-making purposes, if Parliament gave a sanction qualified by the proviso that no coal should be raised for sale by the gas company. But this could be met by a clause permitting the company to dispose of an annual quantity not exceeding some specified percentage of the output. If a company can, like the South Metropolitan, do their own lighterage, or, like the Gaslight and Coke Company, do their own lime burning and their own foundry work, why should they not buy their coal by the seam instead of by the ship load, and do their own mining?

With gas coal selling at 18s. 6d. a ton f.o.b. Tyne, the question may well be asked; and it would be interesting to hear the answers thereto of some of the heads of the gas industry.

Sept. 21, 1900. N. R.

Calcium Carbide Works in England.

Sir,—I note in your issue of the 18th inst., that you say that you have been asked to state that there never have been calcium carbide works at Blackburn. About eighteen months ago, I believe that carbide was manufactured on a small scale at Chatburn, which is near Clitheroe, and perhaps these are the works to which reference was intended.

Derby, Sept. 21, 1900. Hy. Fowler.

The Allowance to be Made for Fast and Slow Meters.

Sir,—I recognize the misunderstanding on which "Gas-Meter" based his calculations, and agree with your correspondents on the matter, in last week's issue, as to the correct mode of testing gas-meters—*i.e.*, by completing one revolution of the proving-wheel, and noting the comparison with the test holder. "W. H. A." mentions having had some difficulty with tables. These are the tables which I presume are issued at the instigation of the Metropolitan Board of Works, for the use of the official inspectors. I also have had some difficulty with these tables. If we take for instance, a meter whose proving-wheel is marked for 100 cubic feet per revolution, at the completion of which the test-holder registers, say 50 cubic feet, by the table the result would be shown as follows:—

Meter registration . . .	100 cubic feet.
Test-holder registration .	50 „ „
Difference . . .	50 cubic feet

Then 50 : 100 : : 50 : 100 per cent. fast.

In this case, a consumer would be obtaining his gas free, if the gas authorities were to allow the deficiency according to the table rule. It will be observed that 50 cubic feet only has been used, as shown by the test-holder registration.

I should feel obliged if some of your readers could throw a little light on the method of compiling this table for gas-meter testing purposes, which up to the present time I have never been able to trace. J. B. P.

Sept. 21, 1900.

MISCELLANEOUS NEWS.

THE GAS POISONING FATALITIES AT TOTTENHAM.

Inquest and Verdict.

The inquiry into the cause of the death of John Jonathan Sanders, aged 43, a house decorator, of 34, Markfield Road, Tottenham, and Arthur, his son, aged 17, who were poisoned by gas (as briefly noticed last week, p. 717), was opened at Tottenham on the 17th inst., by Mr. A. Hodgkinson.

Mr. J. Avery appeared on behalf of the Tottenham and Edmonton Gas Company.

The Coroner, at the outset, said the case was one which he considered should be reported to the Inspector of Explosives; and therefore it would be necessary to have an adjournment. The Home Office, in a circular to coroners, pointed out that, under section 65 of the Explosives Act, accidents resulting from suffocation, or from poisoning or injury by the fumes of an explosive, were required to be notified. He proposed, therefore, merely to call evidence of identification, and the doctor's statement as to the cause of death.

Mrs. *Sanders*, the widow (who was found unconscious when the house was entered, but who had recovered), identified the bodies. She was not asked any questions as to the facts; the coroner saying he would leave her other evidence until the adjourned inquiry.

Dr. *E. R. Hutton* said he was called to the house, and found the father lying dead on the floor of the front bedroom, and the son dead in bed in the back room. The former appeared to have been suffocated on the floor, where he had fallen, and the latter in his sleep. The house, up and down, smelt strongly of gas; and before he could remain long in it, the windows had to be opened. There was a slight glimmer of light in the front room.

The Coroner: Was the burner fully turned on?

Witness: No.

Then there was no risk of an explosion?—I don't know anything about that.

Witness (continuing) said he had not made a post-mortem examination; but he was of opinion that the cause of death was suffocation.

The Coroner directed that a post-mortem examination should be made; and, at the request of Mr. Avery, it was agreed that Dr. Scott should be present on behalf of the Company.

The inquest was then adjourned.

At the adjourned inquest on Saturday Mr. Avery again appeared on behalf of the Company; while Mr. Windsor represented the relatives.

Dr. *E. R. Hutton* was recalled, and gave the results of his *post-mortem* examinations of the two bodies, which were made in the presence of Dr. Scott, the Company's Medical Adviser. He was confirmed in his opinion that death in each case was due to suffocation.

In reply to Mr. Avery, the witness said there were no particular signs of alcohol in the case of the father. The liver was slightly enlarged in the case of the father; but for a man of his size he would expect to find rather a large liver. He weighed nearly 20 stone. Witness stated that when he was called to the house he smelt the gas, and he asked the surviving son John where it was escaping. John immediately turned the gas off at the main service. Witness heard that a shilling had been put in the meter, and he believed it was the son who made the statement. The son was in a dazed condition at the time.

In an answer to Mr. Windsor, the Doctor said that was due to his having inhaled gas. All the symptoms pointed to the fact that the deaths of Mr. Sanders and Arthur were caused by inhaling gas.

Mrs. *Sanders*, the widow, said that on the Friday or Saturday before the occurrence, the Gas Company sent to the house to change the meter, with a view to testing the old one. A new shilling-in-the-slot meter was fixed on the following Tuesday (Sept. 16). Witness did not make use of it. She was told that a shilling had been found in it; but she did not put it in. They used a lamp on the Wednesday night. Her two sons went to bed at nine o'clock, and witness and her husband followed at about eleven o'clock. Witness was the first upstairs.

Further pressed on this point, witness said that she did not remember her husband coming to bed. He remained downstairs to lock up. She did not see him put a shilling in the meter; nor did she notice any smell. She fell asleep, and did not remember any more until she was in the hospital.

The Coroner: Had you been out together during the day?

Witness said they had, and got home at five o'clock.

Was your husband perfectly sober?—Yes.

Witness, continuing, denied that when the new meter was fixed the Gas Company's man asked her for a shilling to test it with, or that he told her not to use it without testing it. He did not say anything to her whatever.

Questioned by Mr. Avery: They always burnt gas; but she was sure she did not use the meter from the time that it was fixed on the Tuesday afternoon until she went to bed on the Wednesday. The reason for that was because there had been some conversation with the fitter about having a penny-in-the-slot meter, and she thought he was going to ask if he could have one.

Mr. Avery: On the Friday the man called with the meter, and you refused to allow him into the house until you had got your husband's instructions?

Witness: I was surprised; and I said I did not think it had better come down then. I knew the man called again on the Monday; but I was out.

I put it to you that he asked you more than once for a shilling to put in the new meter to test it with, and you refused to give one?—No; he did not.

As the man was leaving, did he not tell you, in consequence of your not giving him the necessary money, that if there was any escape you were to at once turn it off at the cock, and communicate with the Company?—No; he never spoke.

Further questioned by Mr. Avery, witness said that on the Wednesday she and her husband were out all day. They went to the City. On their return, her husband went across to a public-house, where he

always went. He never stayed indoors. She also visited it once, or it might have been twice. She came home with Mr. Sanders when the house closed at eleven o'clock. Their sons were then in bed; and the house was in darkness. She went straight upstairs, and used a small piece of candle to light herself to bed. She could not account for the burner in her room being found alight the next day. She did not touch it, and she did not notice at any time during the night that it was alight. She could not say how many times her husband went into public-houses while in the City, but not more than two or three times.

When you left the public-house, was he sober?—He was not drunk.

I do not say he was. Was he quite sober?—I do not know. He appeared to be so to me.

In one of these rooms some shavings were stuffed up the chimney. Who put them there?

Witness replied that she placed them there to prevent the soot coming down on to the bed, which stood against the fire-place. She could not account for the register being down in her room. It ought to have been open. It must have slipped down of its own accord.

By Mr. WINDSOR: The gas fittings were all supplied by the Company.

John Sanders, the surviving son, said he and his brother got home on the Wednesday night at eight o'clock, and the house was then in darkness. They lighted a lamp, and did not touch the gas-meter. They went to bed at nine o'clock. The next he remembered was hearing somebody in the yard. He tried to get up, and felt peculiar. He did not recollect going into his mother's room and then going downstairs to open the door, or turning the gas off at the meter. He was taken to the hospital, and remained there until the Saturday. He did not hear his mother and father return home at night.

In answer to Mr. AVERY, the witness said that his mother came in on the Wednesday night to get their supper, and they left her downstairs when they went to bed. They had three or four lamps in the house. Witness understood there was no gas in the meter, and so did not try it. He did not know a new meter had been put there.

Mrs. *Sanders*, recalled, said they had only one lamp. To reach the meter they had to get on a chair.

William Shields, a gasfitter in the employ of the Gas Company, said that after he fixed the meter he asked Mrs. Sanders on two or three occasions for a shilling with which to test it, and she refused him. He did not feel inclined to put his own shilling in, and therefore left it untested. On the Monday following the occurrence, witness examined the meter, and found an escape at the outlet, to the extent of a foot in twenty minutes. There was a shilling in the slot. A burner in the front parlour was also turned on. The leakage at the meter was one that he would have found out directly if he had put a shilling in the slot. The fitters were not supplied with coins by the Company with which to test the meters. That would be paying for gas for the consumer. As she declined to give him the shilling he turned the cock off, and gave Mrs. Sanders to understand that if there was any leakage she was at once to write to the Company.

By Mr. AVERY: The escape was such that a person standing on a chair to put a shilling in the slot would smell the gas before he could get down.

Mr. WINDSOR: Is it your duty to leave the meter in such a state as to be safe for the inmates of the house?

Witness: Yes.

But you made no test?—I could not make any test. I could not get the shilling.

But if you put a shilling in, and had a key, you could get it out again?—Yes; but we are not supplied with keys.

Witness, further questioned, said he did not consider he left the meter in a dangerous state. He turned the gas off; and he fatted the joint with white fat. It was not their practice to use white lead.

Mr. AVERY: If you had a key, and chose to be dishonest, you could do a good day's work by going from house to house and emptying the meters?

Witness: Yes.

A JUROR: Ought you not to have tested the meter, and then told Mrs. Sanders if she found a leak to write to the Company. That is what has been done when I have had a meter fixed.

The CORONER: The man could not have done more than he did. Do you suggest that because Mrs. Sanders did not give him the shilling, he should have taken the meter away again.

The JUROR: Yes; rather than have left it to the mercy of anybody. It was not Mrs. Sanders's duty to test the meter.

Inspector *Peckover*, who went to the house on hearing of the affair, said that the gas in the meter was nearly exhausted.

Frederick Lambert, who assisted Shields to fix the meter, confirmed the statement that Mrs. Sanders declined on two or three occasions to give Shields a shilling to test it with, and that she was told to write to the Company if there was an escape when she used it. Shields also directed her to turn the gas off. Witness had never known anyone before refuse to give a coin.

The CORONER, in directing the Jury, pointed out that their duty was simply to find the cause of death. They had nothing to do with any other proceedings which might be taken. There was no doubt the deceased were suffocated by gas. The fact that the mother and other son were not, was probably because they were stronger in the chest. It was extraordinary that a gas-jet should have been alight, and yet that there should have been no explosion, although the escape was sufficient to suffocate. He understood from the medical men—and he had looked up the question himself—that gas would suffocate at a lower point than that at which it would explode. Evidently the deceased had been suffocated when there was insufficient gas to produce an explosion. The Jury must consider whether the affair was an accident, or whether anyone was to blame. It had been suggested by Mr. Avery in his questions that Mr. and Mrs. Sanders were more or less the worse for drink, and that one of them put the shilling in without knowing it. What probably happened was that Mr. Sanders put it in before he went upstairs, and lit the gas in his bedroom to see to get into bed, and afterwards fell asleep before the escaping gas penetrated the upper rooms. The fitter Shields did all that he possibly could do, unless he had taken the meter away again.

The Jury retired; and on their return, the foreman gave their verdict as "Accidental Death," and it was entered accordingly. They wished to add a rider; but Mr. Avery objected to it, as being *ultra vires*, and the Coroner upheld the objection.

THE SOUTH METROPOLITAN COMPANY'S TEST OF AMERICAN GAS COAL.

Pending the publication of the results of the trial of American gas coal by the South Metropolitan Gas Company, it is interesting to know how the prospect of a call for coal this side, in any quantity, is regarded in the States.

The "New York Commercial" of the 7th inst. said: In the volume of discussion exploiting the possibilities of an American export coal trade comparatively little has been said of gas coal, for which eventually there will be an enormous demand from abroad. The first indication of the fact that English gas makers are beginning to see the futility of paying more for domestic gas coal of poor quality than they would have to pay for really first-class coal imported from this country, was the shipment three weeks ago of 4000 tons of gas coal from Newport News to the South Metropolitan Gas Company, of London. It was intended to keep this deal quiet; and it did not gain publicity until this week. It is not known what price was paid for the coal; but the experiment has been so successful that similar transactions are expected this month. The English gas producer is now paying between $6·50 and $7 a ton for a very poor quality of gas coal. The British home supply has been gradually reduced until now the gas maker is losing money not only on the price of his coal, but on the consumption thereof, owing to its poor quality. First-class gas coal is now selling in New York at about $3·10 a ton. It can be laid down at Newport News for export at $2·60 a ton; and figuring the cost of ocean transportation at $3 a ton, it is seen that for $5·75 a ton at most the English gas manufacturer can get an American coal which is far superior to the degenerated product for which he is now paying between $6·50 and $7. The best American gas coal comes from the Youghiogheny Valley region, or from the Virginias, Pennsylvania, or some parts of Maryland. The American gas trade is not pleased at the prospects of a heavy foreign demand for gas coal, because it would likely increase prices on the home market.

In this connection, it may also be of interest to give the following notes by the London Correspondent of the "Yorkshire Post" upon an interview which he had last Friday afternoon with Mr. C. C. Carpenter in regard to the use of American gas coal. He writes:—

With a view to ascertaining the results of the experiments carried out by the South Metropolitan Gas Company with the object of deciding the relative merits of the American coal imported into this country from America, and of the products of the Durham and other British coal-fields, I took an opportunity this afternoon of talking over the whole question with Mr. C. C. Carpenter, the skilled Engineer to the Gas Company, under whose superintendence the experiments are being conducted. The position, it will be remembered, is practically this: English gas coal costs the consumers just about 20s. a ton. American coal can be bought much cheaper on ship at Philadelphia; but, when freightage is added, the cost in the English market is something like 27s. per ton. Thus, to make the use of the imported coal economically possible, it will have to be shown that the amount of gas it produces is as much more in volume or in purity as will justify the extra expenditure. If the word of the agents of the Transatlantic coalowner might be taken as scientifically correct, there would be no doubt on the economic question. They allege that a ton of American coal will produce 15,000 feet of gas; whereas the English article yields only 10,000 feet. These figures are not likely to be confirmed by the test being made at the Deptford works; but it is certain they will give results which will have a very important effect on the future of gas manufacture in this country, and of the coal consumption in many other parts of the world.

"I cannot tell you the results of our experiments statistically," began Mr. Carpenter, "for the reason that they are not yet complete, nor will they be for ten days or a fortnight yet. But you may take it that the high opinion we formed of the coal after the first week's use is well maintained. The American coal is excellent—certainly we have never found any so good. From whatever point you view it, it is a remarkably good coal for the gas maker. The yield of gas is copious; it is very free from sulphur, which with us is a great consideration; and the residuals are also good."

"Upon those you depend much for profit?"—"Very much indeed. The cheapness of gas in England depends to a very great extent on the residuals, and especially upon coke. The coke from the American coal is a very fine, hard production, and will be greatly appreciated in the market."

"But it is a dearer coal?"—"Dearer in the English market; and so far as its use in England goes, everything depends on the practical results. We are not hurrying our tests. We are determined they shall be accurate. But our action in buying American coal has already had two remarkable results. The first is that it will lead to the very general use of American coal in places where it has never been used before. Take France and Portugal, for instance. They are large buyers of English coal. It costs them not only the price at the port of loading, but also the freightage. Therefore, the American coal is to them just about as cheap as the English coal, and they will now find that the yield is better. All the ports along the Mediterranean will find American coal actually cheaper. More remarkable is the state of affairs in South America. Hitherto South American gas-works, speaking generally, have been supplied with English coal. Their managers do not seem to have dreamt that a coal was procurable in the north of their own continent which was not only as good a coal generally, but for their purpose better. Now they are ordering coal from the United States, and to that extent the English coalowner must suffer."

"This must have an effect on prices?"—"Yes, prices are already slightly affected—not much, because the thing is in its infancy, and the strike of colliers in America has kept up prices there. But eventually prices must be very much affected, to the great advantage of gas makers in this country."

"You mentioned a second notable result of your action?"—"I was referring to offers we have had to supply us with coal from Canada. We have already had visits from the representatives of coal-fields in Canada submitting samples of coal which promise to be equally as good

as that we have received from the States. The position is attended with great possibilities. We have one offer from a part of British North America some hundreds of miles nearer England than the States, where coal is comparatively low, and freightage less than from Philadelphia. Into this offer we shall go with care."

The view of the officials (says the "Yorkshire Post" correspondent in conclusion) at the great gas-works in South London is evidently that the price of coal in London is unduly inflated, and that the reaction will not be long delayed.

THE LEAMINGTON GAS-WORKS PURCHASE QUESTION.

The Corporation Forward the Steps Necessary to Obtain Release.

The Meeting of the Leamington Town Council specially convened for the purpose of receiving a report from the General Purposes Committee on the letter of Mr. Hassall, the Solicitor to the Gas Company, regarding the Council's application to withdraw their notice to purchase the gas undertaking, was held on Monday last week. The Committee stated that they had considered the letter, and recommended "that the Town Clerk be instructed to officially communicate to the Company that it is the desire of the Council, as a body, to withdraw the notice of purchase of the Gas Company's works, and, if necessary, they will be prepared to promote a Bill to obtain parliamentary sanction to this, and pay such costs of the Gas Company since the notice was served upon them to purchase, to the conclusion of the matter, including, if necessary, the cost of the representation of the Company by Counsel before any Parliamentary Committee." The Mayor (Mr. J. M. Molesworth) moved the adoption of the report; and it was seconded by Mr. Heath Stubbs. Alderman Bright followed with an unnecessarily long speech in which he reviewed the history of the affair, for the purpose of showing that a charge of vacillation which had been made against him was unfounded. The Council had, in his opinion, made a mistake; and therefore the suggestion of the Gas Company was a very liberal one, seeing that they had the Council in their fingers. The demands of the Company were such that they would not injure the Council much if they paid them. They would thereby get rid of an incubus which was troubling them, and had troubled them for some years. If the works were acquired by the Corporation, both the price of gas and the rates would be increased. He did not agree with the system of the municipalization of businesses, which was becoming so common. Mr. Barratt was convinced that the moment for the purchase of the works had not arrived—not because he thought the price prohibitive, but because of the rise in the money market. When the Council passed the resolution making the offer to purchase, they were not aware they were going to have a South African war, nor that the prices of money and materials were going up so considerably. Alderman Davis pointed out that money was dearer last November than it was now. The report was carried *nem. con.* It is evident the Council are prepared to cheerfully pay whatever is necessary to get rid of their obligation to take over the works.

ST. HELENS CORPORATION GAS AND WATER SUPPLY.

The annual statement of the St. Helens Corporation accounts, prepared by Mr. John Brown, the Borough Treasurer, shows that on the gas-works account, the total income, including £35,805 from the sale of gas and £13,562 from residual products, was £49,790; the total expenditure, £40,934—leaving a balance profit for the year of £8855. The expenditure included £22,052 for the manufacture of gas, £2142 for distribution, £2316 for rents, rates, &c., and £1624 for management. Out of the reserve fund there had been expended £3461 in the repair of the holder smashed in the explosion in May last year, and of other damage caused by the occurrence. The present reserve fund is £7802.

On the water-works account, the total income, mainly from water rents and charges, was £24,145; and the expenditure £23,548—leaving a surplus balance of £596. The expenditure was principally on repairs and management expenses at the various pumping stations. The balance in the reserve fund is £8417.

DAVIS GAS-STOVE COMPANY, LIMITED.

The Statutory Meeting of this Company was held on Thursday last at Winchester House, E.C.—Mr. HENRY J. DAVIS in the chair.

The SECRETARY (Mr. C. S. Barber) having read the notice convening the meeting,

The CHAIRMAN said they would all be aware that this was merely the statutory meeting of the Company, which they were compelled to hold within four months of incorporation. There was no business to discuss; but it was customary on such occasions to inform the proprietors whether or not the shares publicly offered had been subscribed for, and to tell them whether things were in a satisfactory condition. First, he might say that all the shares—both ordinary and preference—which were offered to the public in the prospectus had been subscribed for; and at as early a date as might be convenient, a settlement on the Stock Exchange would be applied for, which would enable proprietors to judge of the value of their holdings. With regard to the second point—how they were progressing—he could only say that at no period during the existence of the business had they done so much work in the time as the present year. But he must add that, had they been able to execute their orders more promptly, the business done would have been even greater. Their inability in this respect was the reason that compelled them to ask the public to join in the undertaking. He would go back some years, and give the shareholders a short *résumé* of the history of the concern. He believed that it was in 1875, when his brother Mr. C. W. Davis and his cousin Mr. Price, in partnership with himself, were trading as ironmongers in Camberwell and Clapham, that they first took up the manufacture of gas-stoves. At the time gas companies were realizing that a very considerable increase in consumption would ensue from letting-out gas-stoves on hire. His firm, therefore, made a sample cooker, which they submitted to Mr. George Livesey, who suggested certain modifications. The result was the production of a stove which was practically the type of all gas-stoves now manufactured by every maker. The firm were at the time in a comparatively small way; but when once a good stove, answering all necessary requirements, was brought forward, it was wonderful how the business progressed. They soon came to the conclusion that it was desirable to carry on this branch of their trade as a separate business; and they accordingly secured manufacturing premises at No. 200, Camberwell Road. Each year since they had had to make some addition, until at the present time they had six houses in the Camberwell Road and four others in the near neighbourhood, as well as thirteen railway arches. So it had gone on, each year finding them in the same predicament as the preceding one—that was to say, in the height of the season they were always in arrear with their deliveries. In 1895, they found it necessary to purchase a large interest in a foundry at Luton; but even after this, they were in the same position. Last year, therefore, they saw that it had become necessary to obtain financial assistance, to enable them to still further develop the business. With the funds obtained from the shares that had been taken up, they had purchased not only the Luton foundry, but also a larger one at Falkirk; and a substantial balance still remained to provide for further expected developments. With regard to the Scotch works, it was not their intention to use these as a foundry only, for they were erecting extensive fitting shops there. Up to the present they had done little or no business in Scotland, owing to the cost of carriage; but when the new fitting shops were in full swing, they would be able to supply stoves there, as well as in the North of England, cheaper than they could now do. He might mention that his son, Mr. Harold Davis, would take over the management of the two foundries. Almost all, if not all, the members of the staff were shareholders in the Company; so that no effort would be wanting on their part to make the concern a success. He thought, therefore, that from every point of view—effective management, faithful service, and the general outlook of trade—the proprietors had reason to look forward to a brilliant future for the Company, and a satisfactory return on their investment.

There being no questions asked, the proceedings then terminated.

THE LIGHTING OF BALTIMORE.

The Secretary of the Baltimore Lighting Committee has communicated to the "Annals of the American Academy of Political Science" the following particulars from the report of the Municipal Lighting Commission appointed by the City Council to inquire into the cost of lighting the city.

The present movement of inquiry into the question of municipal construction and control of an electric lighting plant in Baltimore was started in the summer of 1899. It was not until Jan. 4 of the present year that the Municipal Lighting Commission was created, and its course outlined in a resolution of the Mayor and City Council. The duties of the Commission were to report as to the "feasibility, practicability, and expediency" of the establishment of a municipal lighting plant by the city as the principal matter, and to report by Feb. 15 as to the cost of public lighting, both by gas and electricity, in cities of the United States, equal to, or greater than, Baltimore in population, to be the subject of a preliminary investigation, together with recommendations as to the best method of reducing the price of lighting to the city.

This particular phase of the question was brought about by the general impression existing in the minds of the public that the people and the city were paying an extortionate rate for both private and public lighting; and the question was at the time being agitated before the Maryland Legislature to reduce the price of gas, from the present rate of $1·25 per 1000 cubic feet to $1. The actual result has been to reduce the price of gas to $1·10.

The Municipal Lighting Commission had but one month in which to make this preliminary investigation, but secured results from cities in this country, which, together with a general knowledge of the situation as it existed in Baltimore, enabled the Commission to arrive at definite conclusions, and based upon these conclusions, to point out wherein it was possible for the city to secure a reduction in the price of its public lighting.

The first conclusion reached was that, with gas at $1·25 per 1000 cubic feet, Baltimore paid more for its lighting than any city of large size in the country—15 per cent. more than the next highest in price. The second conclusion was that, despite the fact that there had been steady reductions in the price of both electric light and gas to the city for some years prior to 1890, and that economies in manufacture warranted a further reduction, there had been no reductions made in the price of electric light for ten years, or of gas for twelve years. This state of affairs was the result of the monopoly enjoyed by the Gas and Electric Companies. There was only one Gas Company; and while there were two Electric Companies furnishing street lights, there was no competition—the city lighting being divided between the two Companies; the price being 35c. per night, or $127·75 per year, for each 2000-candle power arc light. A third conclusion was that, in comparing prices in Baltimore with those in other large cities, local conditions as to cost of material and labour entering into the manufacture were not unfavourable to Baltimore.

The Commission pointed out the means by which the price could be reduced to a reasonable amount; and they are here mentioned briefly: 1. Properly regulated competition—unrestricted competition being considered the least advisable of any method. As has happened heretofore, it surely results in further consolidation and aggravation of the evils. 2. By making contracts, and providing, if possible, for reductions in price as the number of lights increase. 3. Reduction of price by Legislature. This has been done in respect to gas lighting as heretofore mentioned. 4. Municipal plant.

The Commission makes no recommendation as to the expediency of municipal control, but indicates that, if all other methods fail, there is yet this question to be determined, which may or may not result in a reduction of cost to the city, and upon a determination of the matter of reduction in price would rest the advisability of a municipal plant.

The report recommends: First, the passage of a Bill then pending in the Legislature to appoint a Franchise Commission, with proper powers, and to represent the public in dealing with public service corporations.

This measure was defeated. Second, the passage of an Act enabling the city to issue bonds to provide the necessary funds to construct a lighting plant, after submission to a vote of the people.

This Act has become a law; and with this power in its hands, the city of Baltimore should be in a position to deal with Lighting Companies, and secure its lighting at a fair and reasonable price. If it fails in this purpose, there is yet the question of a public plant; and it is expected that the principal report of the Commission will determine this point, and that it will give good and sufficient reasons for its conclusions, whatever they may be.

ELECTRIC LIGHTING NOTES.

With considerable ceremony, the "corner stone" of the electricity works for the Farnworth District Council has been laid. The station is intended for both lighting and tramway traction; and the combined scheme is estimated to cost £22,000. In addition to the requirements for the tramways, the generating station will be capable of supplying current for 6000 16-candle power lamps and a number of arc lights for public purposes.

Some time ago the Birstall District Council had pressed upon their notice, as the outcome of a discussion at a meeting of the Chamber of Commerce, the desirability of putting down an electric lighting plant. At that time, however, the Council thought that it would not be wise to take up the matter, especially seeing that the gas-works belonged to the town. Since then a private Company have given notice of their intention to apply for powers to supply electrical energy in the district; and in order to keep out the Company, the Council have now decided to themselves apply for a Provisional Order.

The members of the Committee of the Brighouse Corporation who manage the electrical business received quite a shock at a recent meeting. A special report was presented by the Electrical Engineer (Mr. E. Wilks), who, with some emphasis, drew attention to the fact that "the present electrical plant has now reached that stage when depreciation is taking place far greater than that allowed for in any preceding year." In other words, the members of the Committee were given to understand that the plant is totally inadequate for the work it is called upon to do; and, in consequence of the severe strain caused by overloading, the wastage is out of all reasonable proportions. What is worse, breakdowns are of such frequent occurrence as to endanger the public service. It has been decided to approach the Halifax Corporation as to the terms on which they will supply Brighouse with electricity.

Electricity consumers in Manchester continue to suffer; and many are the bitter complaints to which the officials of the department have to listen. Now and again, personal complaint not resulting in the mending of matters, public appeals are made in the correspondence columns of the local Press. Here is a sample, dated Sept. 20: "We are only just getting into dark days; and two evenings in succession the electric light has failed us. What will our condition be before the light evenings return to us? Last winter the electric light failed us so often that it began to be a nuisance, and compelled us to put in again gas-fittings that we were led to believe we could discard. Until our generating stations are in better working order, would it not be as well for our Corporation to cease extending? Evidently they are not able to cope with the demands made upon them." The failures referred to here are mentioned in our "Electric Lighting Memoranda."

According to the "Financial News," a new discovery by Edison—the production of electricity direct from coal—is imminent. Our contemporary says: "Edison's ingenuity seems inexhaustible! He is now credited with an invention 'which will eventually supplant the steam-engine and make electricity direct from coal—abolishing the necessity for dynamos.' The inventor has been working for some years on the solution of cheapening the manufacture of electricity. At present the details of the process are kept secret; but the machine, it is said, will be portable and inexpensive, and it is constructed on the principle that cold contracts and heat expands any substance. The new method is to be applicable to automobiles, electric launches, lighting plants, power houses, phonographs, and many other things. Naturally enough, a Company is being formed in New York to exploit the invention. The story is readable, at any rate, if untrue, at a time like the present, when any plan calculated to result in an economy of coal and lower prices for fuel makes a very direct appeal to the long-suffering householder on this side of the Atlantic. If Edison has solved a problem which has been exercising the wits of scientists and engineers for many years past, and made a discovery the value of which in hard cash is hardly calculable, it seems a little surprising that he should have allowed a New York Company to handle his invention at all."

"Notes and Comments" from the "Wakefield Express": "The Wakefield Corporation have got the Local Government Board's sanction for a loan to pay for the extension of the electric lighting plant. But they have not got all they asked for. Contingencies were put down at 20 per cent. on the proposed outlay. But only 10 per cent. has been allowed; and £60 for tools, &c., has been disallowed as a capital charge, and must come out of revenue. The Local Government Board have let off the Corporation very leniently in reference to the Committee's unwise and risky action in spending about £4000 beyond their original borrowing powers. A much needed caution—'Don't do it again'—has been given, however. We believe that the Bristol Corporation recently trespassed in a similar way, and the money over-spent had to be replaced out of the rates. It would have been a serious thing for the ratepayers if the Local Government Board had been as strict with Wakefield as with Bristol, and required the surplus expenditure to be paid out of next year's rate, or by a special rate of 1s. in the pound." "The public arc lamps in the city continue somewhat eccentric in the performance of their duty. Most nights one or another of them fails to shine; and, the gas-lamps in their vicinity having been done away, darkness is peculiarly visible. When first set up, irregularities of this sort were excusable, to a certain extent; but it is surely time that the apparatus should have been got to work with something approaching to certainty."

The troubles of the Hanley Corporation in connection with their electric lighting undertaking came under the notice of Mr. H. Percy Boulnois, one of the Inspectors of the Local Government Board, on Friday. The Corporation had asked the authority of the Board to the borrowing of £9500 for the provision of a refuse destructor, and £4000 for the purpose of electric lighting. The portion of the inquiry relating to the destructor was quickly disposed of; and then, in connection with the requirement for electric lighting, it was explained that the sum named was needed for additional buildings—a chimney stack, two new boilers, and appurtenances. Previous loans sanctioned for electric lighting totalled £70,009; but the amount actually borrowed was £64,190, commencing with the original loan of £21,000 in February, 1893. The demand for the light was continually increasing, notwithstanding the fact that it had been necessary to advance the prices for the current on account of the deficiency occasioned by increasing wages and materials, lowering the price too soon, and other causes. The question of the financial results of the working of the undertaking was introduced by Mr. W. H. Folkes, who thought the fact that a year's working showed a loss of £2690, after paying instalments of loans and interest, went to show that the undertaking had been mismanaged. He did not think the Corporation should be allowed a further loan until an expert had been engaged. Alderman Hammersley, however, gave figures to show a better result during the present financial year. Further, the £2690 referred to could not, he said, be considered as a loss. In five years' working they had paid off £5000; and they could not regard a sinking fund as a loss at all. Mr. Folkes contended that the leakage of electricity was excessive at Hanley; but Mr. Cowell (the Electrical Engineer) said there was no leakage in the way that had been noised about. There was some loss in transmission, which was always the case. Dr. Adler supported Mr. Folkes's views, and said they simply wanted to be satisfied that the undertaking was being carried on with due skill, foresight, and capacity. He asked that the Local Government Board should attach to their sanction to the loan a condition that it would not be granted until an expert had been engaged, and had reported. The Inspector said much of the loan now applied for seemed to be urgently wanted. If they waited for an expert, it would require some considerable time before they could get the loan. He had made a note of the objections and recommendations.

FALMOUTH CORPORATION AND THE WATER-WORKS.

The Corporation of Falmouth have received from Mr. A. F. Phillips a report on the condition of the water supply. Like Mr. Silverthorne, Mr. Phillips advises the Corporation to acquire the works from the Falmouth Water-Works Company, and to take steps for the protection and improvement of the supply. The sanitary arrangements of many of the farms and dwellings in the vicinity of the stream supplying the town is, he says, very unsatisfactory; and the arrangements for filtering the water are not good. In addition to works for protecting the water from contamination, he advises the raising of the level of the upper reservoir by at least 2 feet, which would increase the storage from 60 to 80 million gallons—equal to 160 days' supply of half-a-million gallons. A new set of filter-beds should be constructed, and a covered service reservoir. There should be a second pumping plant for the supply of the high-level district, in connection with which also there should be a covered service reservoir. A considerable length of larger main is necessary; and the whole of the mains require cleansing to remove the vegetable deposit. The cost of the proposed works is estimated at £23,500. Although the purchase and improvement of the water-works may entail a slight charge upon the rates, the benefits derived should more than compensate for this.

THE NEW WATER RESERVOIRS FOR HALIFAX AT WALSHAW DEAN.

An important municipal function was carried out, on behalf of Halifax, at Walshaw Dean yesterday week. It was the cutting, by the Mayor (Mr. W. Brear), of the first sod of the new Walshaw Dean reservoirs. Something like 220 guests were conveyed to the scene of operations; but the actual ceremony was witnessed by, it is computed, about 800 persons. Arriving upon the site, the Engineer of the scheme (Mr. G. H. Hill) introduced the Mayor to the Contractor, Mr. Enoch Tempest, who presented his Worship with a silver spade and a silver-mounted ebonized wheelbarrow commemorative of the occasion. The task of cutting the first sod and wheeling it away appeared to the onlookers to be a very easy duty to the practical Chief Magistrate; and he was loudly cheered. Afterwards the invited guests had luncheon in a marquee; the Mayor taking the head of the table. A number of toasts were honoured; and the speeches showed that there was a oneness of opinion as to the wisdom of the Corporation undertaking this great work.

Regarding the new reservoirs, it may be stated that, when the Walshaw Dean system is completed, the Halifax Corporation will be in possession of the entire drainage area from the Ovenden Moors on the north, over the Warley, Luddenden, Midgley, Walshaw, and Wadsworth moorland ridges, right to Boulsworth Hill. And, with the exception of a few peaty streamlets flowing from the Greave Clough Moors and a portion of the Warley Moor area, the water is of excellent quality, and the supply ample to satisfy all the wants of growing Halifax and its many dependent districts. The site of the new reservoirs is about 1150 feet above sea-level, and is situated on the fringe of the moorlands. The scheme comprises three reservoirs, of about equal size; and their combined capacity will be 650 million gallons. The surface area altogether will be about 155 acres. The sites of the three reservoirs occupy the northern end of the valley, and lie, as it were, one above the other. The Walshaw drainage area is some 2325 acres in extent, almost exclusively moorland. Of course, in acquiring the important water rights over so wide a drainage area, the Halifax Corporation have to undertake to supply an adequate compensation flow into the Walshaw stream, which empties itself into the Hebden at Blagden Bridge. The quantity of compensation water to be supplied is 1,600,000 gallons per day; and the stipulation has been imposed, at the instance of Lord Savile, that the compensation water shall be given in a continuous flow through each day of the year at the rate of $2\frac{3}{4}$ cubic feet per second. Mr. Tempest's contract for the construction of the works is £170,000. The purchase of land, rights, &c., absorbs above £30,000; and it is expected that with extras, &c., the total outlay will be about £220,000. The scheme will add something like $2\frac{1}{2}$ million gallons to the daily supply of the town.

NEW RESERVOIR OF THE OLDHAM CORPORATION.

In the "JOURNAL" for the 14th ult. (p. 433), we recorded the opening of the Rooden reservoir of the Oldham Corporation. As this work completes the water scheme for which the Corporation obtained powers, it may be of interest to place on record some particulars respecting it.

The first turf was cut by Mr. Adam Lee, J.P., on July 30, 1894. The reservoir has a top water area of 21 acres, is at an elevation of 1068 feet above Ordnance datum, and has a capacity of 265 million gallons. The natural gathering-ground is only 25 acres, which is augmented by collecting the flood waters from 370 acres in the Denshaw Valley and 423 acres from the Piethorn Valley; making a total of 818 acres. The reservoir is situated at the division of two watersheds draining in opposite directions, which has necessitated the construction of two large embankments. On commencing the works, it was found that the interior of the reservoir was covered with peat varying in thickness from 2 to 14 feet; and its removal being considered advisable, it was excavated and tipped below the northern embankment. Being in a wet condition, the peat at once began to slide, and another embankment 270 feet long and 40 feet high, and containing 11,890 cubic yards of banking material, had to be constructed to prevent the peat flowing into, and filling up, the Hanging Lees reservoir, situated immediately below. This additional work has, of course, added considerably to the cost of the undertaking. The quantity of peat excavated amounted to 107,500 cubic yards.

The north embankment is 578 feet long, with a maximum width of 484 feet, and a maximum height of 83 feet, and contains 179,500 cubic yards of banking material. Its top width is 17 feet, the inclination of the outer slope, which is soiled, being 2½ to 1, and that of the inner slope, which is pitched and shingled, being 3 to 1. The puddle trench for this embankment is 12 feet wide and 676 feet long. It has been sunk to a maximum depth of 114 feet below the natural surface of the ground, involving 19,687 cubic yards of excavation, the filling in of which comprises 11,342 cubic yards of puddle, 7055 cubic yards of cement concrete, and 700 cubic yards of lime concrete. The puddle wall above the natural surface of the ground has a maximum height of 84 feet, is 8 feet wide at the top, and batters 1 in 12 on each side; the total quantity of puddle being 13,989 cubic yards. Some open strata being found in the west end of this trench, a wing trench 6 feet wide, 165 feet long, and averaging 20 feet deep, has been sunk to cut off any escape of water through this strata. The trench has been refilled with 285 cubic yards of cement concrete, and is surmounted by a masonry wall carried to a height of 2 ft. 6 in. above top water level. The quantities of shingling and pitching on the inner slope are respectively 6614 superficial yards and 5613 superficial yards; and the soiling on the outer slope amounts to 7024 superficial yards. The valve-shaft, which is reached from the embankment by a girder bridge, of 28 feet span, is constructed of masonry and cement concrete, and lined with white glazed bricks, is 89 ft. 9 in. high, 7 ft. 6 in. square to a height of 10 ft. 6 in. from the bottom, and 7 ft. 6 in. diameter from that height to the top. It is surmounted by an octagonal masonry valve-house, containing the capstans for working the valves controlling the flow of water from the reservoir. These consist of a 24-inch valve drawing off at a depth of 78 feet below the top water level, an 18-inch valve drawing off at a depth of 42 ft. 6 in. below, and an 18-inch valve drawing off at a depth of 18 ft. 6 in. below. The discharge tunnel from the reservoir to the valve-shaft is built in cement concrete 18 inches thick; the internal dimensions being 3 ft. 6 in. wide by 3 ft. 6 in. high. The tunnel under the outer slope of the embankment is composed of cast-iron pipes 42 inches in diameter, and discharges into a well at the foot of this embankment, where it is joined by the overflow channel. The overflow well, situated near the valve-shaft, is circular, 9 feet in diameter and 7 ft. 6 in. deep, built in masonry and concrete. The overflow channel commencing in this well, and running to a well at the foot of the outer slope, a distance of 462 feet, is built of cement concrete with flagged bottom, being 5 feet wide and 5 feet high. From the last-named well, into which the discharge tunnel is also conveyed, a culvert 5 feet wide and 5 feet high is constructed to convey the waters from either the overflow well or the discharge tunnel into a third well 5 feet square, and built in masonry and concrete, where they can be discharged into a line of pipes 28 inches in diameter, controlled by a 33-inch wall-sluice, and thence into the Hanging Lees reservoir, or be conveyed by means of a line of pipes 18 inches in diameter into the flood channel at the northerly side of the Piethorn reservoir.

The south embankment is 1518 feet long, with a maximum width of 365 feet and a maximum height of 69 feet, and contains 200,804 cubic yards of banking material. Its width, inclination of slopes, and the materials of which it is composed, are similar to those described for the north embankment. The puddle trench is 1550 feet long, and has been sunk to a maximum depth of 76 feet below the natural surface of the ground, involving 21,855 cubic yards of excavation, the filling in of which comprises 21,571 cubic yards of puddle and 284 cubic yards of cement concrete. The puddle wall itself above the natural surface of the ground has a maximum height of 69 feet, and varies in width from 6 feet at the top, battering 1 in 12 on each side; the total quantity of puddle in the wall being 18,456 cubic yards. The shingling and pitching on the inner slope of this bank amount to 6113 superficial yards and 7664 superficial yards respectively, and the soiling of the outer slope covers an area of 15,931 superficial yards.

The reservoir is supplied with water from the Denshaw Valley by means of a tunnel, into which the water is diverted by a masonry and concrete weir controlled by a sluice 5 feet wide and 2 ft. 6 in. high, worked by a capstan. The width of the weir is 20 feet, and is crossed by a girder bridge of the same span. The tunnel, which has been driven almost entirely through rock, is in the middle 150 feet below the surface of the ground, is 5 feet wide by 4 ft. 9 in. high, built throughout of cement concrete, with an inclination of 10 feet in a mile. The side walls and arch are 12 inches and the invert 9 inches in thickness. The length of the tunnel which has been driven and lined is 551 yards, and some 201 yards have been constructed as "cut and cover." This terminates in an open channel running into the bottom of the reservoir; a distance of 125 yards, having a top width of 10 feet, a bottom width of 5 feet, and a depth of 2 ft. 6 in., being built with a cement concrete lining, and covered with 9-inch pitching.

The whole of the works have been designed by Mr. George H. Hill, M.Inst.C.E., of Manchester and London—the Resident Engineers being Mr. W. Watts, F.G.S. (at present the Engineer for the Langsett works of the Sheffield Corporation), during the first portion, and Mr. C. J. Batley, Assoc.M.Inst.C.E. (the present Manager), during the latter portion; and they have been carried out entirely by the administration.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Gas matters bulked largely in the business before the Glasgow Town Council at their meeting this week, when another toll was given to that bell which we were informed was to be kept ringing in the Council until they recognized the right of the gas workers to be represented by the officials of their Union. In another month, the municipal election will be over; and possibly after that the ringing will not be so vigorous for some time. The proceedings began by the announcement that a communication had been received from the Glasgow Trades' Council asking the Town Council to receive a deputation of gas workers. A question was raised as to whether it was customary for the Council to receive a deputation of their own employees; but it was brushed aside by Lord Provost Chisholm, who said it was usual for them to receive any deputation of citizens. The deputation, which consisted of over 100 gentlemen, was then introduced. Mr. W. Blackwood, the Secretary of the local branch of the Gas Workers' Union, said the object of the deputation was to draw the attention of the Council to the manner in which a deputation from the gas workers had been received by the Gas Committee, and also to see that the Council should form a true estimate of the grievances which existed. The deputation of gas workers received by the Gas Committee was not a proper deputation, owing to the fact that one-half of it consisted of men chosen at the instigation of the Managers of the works, and the other half of men who were elected by ballot of the workers. Only one-half of the deputation was received; and that half consisted, practically, of the men chosen by the Managers. He hoped the Council would see that the men had liberty to select their own deputation, without the interference of officials; and that the deputation so selected would be allowed to lay before the Gas Committee a true statement of the grievances which existed. Mr. J. M'Laghlan, of the Glasgow Trades' Council, supported the position taken up by the gas workers. He considered their request a reasonable one, and thought that the deputation should be a *bonâ fide* one, appointed by the men themselves. Lord Provost Chisholm assured the deputation that their views would receive the attention of the Council.

The minutes of the Gas Committee contained a report of the conference which took place on June 28 between the Gas Committee and their workers, and stated that, by a majority, the Committee recommended that no further action be taken in regard thereto. Mr. R. M. Mitchell, the Convener of the Gas Committee, in moving the adoption of the minutes, said he was sure the Council would be convinced that the Committee had arrived at a wise decision in this matter. There was not one member of the Committee who did not desire that their workmen should be as well treated and as comfortable as any workmen in the city; and he believed that they had fairly succeeded. He made bold to say that there was no interference with the gas workers either on the part of the Engineer, the Managers, or the Committee. The Committee desired, in the interest, not only of the workers, but of the citizens, that the utmost harmony should prevail in regard to this department of their works. The Council were trustees for the public; they were not there to act in the interest of a section of the people. He made bold, also, to say that there had been no intimidation or oppression; and that nothing that would tend in any way to make their workers' lives uncomfortable or harsh would be tolerated either by the Gas Engineer or by the Committee. With regard to the deputation who had appeared before them that day, he only wished to say that neither the Engineer nor himself had the least indication that such a deputation was to be appointed. He did not know how they had approached the Council so unexpectedly; and he could only say that he hoped the Council would continue to have confidence in the Gas Committee, in their Engineer, and in their Managers, and that they would listen to no *ex parte* statement or anything that might for a moment stop the Committee in doing what they sought to do—namely, to discharge their duty in every respect to the satisfaction of the Council and the citizens. Mr. Shaw Maxwell said that those who supported the deputation had full confidence in the officials, and believed that they were very well served. But they also thought it was right and proper that, if the men in their employment were to be heard either by the Committee or the Manager, they should have the liberty of delegating the men to represent them, and that they should not be named by the Managers of the various works. This was all the men claimed; and he considered it was a very moderate claim. Mr. P. G. Stewart moved the amendment he had proposed in Committee—that a Special Sub-Committee be appointed to inquire further into the several matters referred to in the report. He agreed with the Convener that the councillors were there as custodiers of the public interest, and not for any one section of the public. At the same time, it was their duty to see justice done to the men in their employ; and he contended that the statements made before the Committee justified his proposal. He further stated that for some time there had been in the gas-works victimization, which had been denied by Mr. Foulis and by certain members of the Gas Committee. Men, because they had taken up a certain attitude, had been dismissed; and surely there was some ground for his statement when these men were reinstated by Mr. Foulis. Even that was enough to show that there was need for inquiry. Treasurer Murray said this matter involved a vital and important principle in connection with the management of the gas-works. The men were before the Committee, and stated their case with great propriety. There were practically three grievances. The first was with regard to the Dalmarnock works, when it was stated by one of the men that he and some others had been longer in the yard this season than in former years. The Manager assured the Committee that the matter would be inquired into; but, in any case, he held that these were details in connection with the gas-works which should be entrusted to the Manager. The second grievance was that of Sunday labour; and the Committee were told that this had already been remedied. The third matter was the *crux* of the

whole situation, and that was the question of signing on. This was the secret of all the grievances which had been brought before them on this and on previous occasions. Now, he would point out that gas-works were different from almost every other kind of employment. They were so recognized by the Legislature, which had made it criminal for workmen to leave without notice; and it was the duty of the Corporation to conduct their works in the interest of the whole community. This was not a question between Labour and Capital at all. It was a question as to the safety of the community; and if the Manager, under the direction of the Committee, did not take every precaution he possibly could to secure that the works were carried on continuously, and without danger of interruption from outside sources, he would not be doing his duty to the community. Nor would the Committee be doing their duty unless they took every means in their power to secure that the works were carried on continuously, and without fear of interruption such as they had last winter, when 200 or 300 men left the works at the instigation of outside people, and threatened to leave the city in darkness. What a situation it would be if these enormous works, on which the comfort and safety of the community largely depended, were to be at the mercy of some outside organization which could bring out men at an hour's notice. It was perfectly clear that the signing-on system was essential—or desirable at least—to the safe conducting of the works. He went further, and said that Mr. Foulis ought to give a privilege to men who signed on. Bailie J. W. Dick supported the amendment. With reference to the members of the deputation from Dawsholm, he made a statement with regard to the method adopted in their selection, the result of which was that when they came before the Gas Committee it was found that only one man had been selected under the ballot of the men, while two had been selected from shifts by the Manager. The man selected by ballot, and one of the men selected by shifts, left the meeting; and only one man from Dawsholm remained. The deputation who had appeared before the Corporation earlier in the day made the method of selection by the Manager their chief cause of complaint. As to signing on, this was the most important question of all; and, while he did not wish to speak of victimization, it did seem that favouritism had been shown. Mr. Battersby said all that was asked was that a Committee should be appointed to inquire into the whole matter; and this, he held, was a fair and reasonable request. Reference had been made to the signing-on; and it was true that this was the *crux* of the whole question. Treasurer Murray had spoken of putting the city in darkness. In doing so, he was "drawing the long bow." Did they suppose that any body of workmen would be permitted to put the city in darkness? Were any such attempt made, they would be able to fill the works twice over. Mr. R. M. Mitchell, in reply, stated that, so far as the representatives from Dawsholm were concerned, they were selected by the men themselves, without any interference or dictation by the Manager or anybody else. He would also like to say, with reference to the selection of delegates, that outside the gates papers were handed to the men, containing the names of three men for whom they were to vote. He did not wish to state by whom this was done. Then with regard to the signing-on, there was no compulsion of any kind applied to any man to sign-on or not to sign-on; but those who did so, and were good workmen, naturally received preference when there was an opportunity of their continuing work. He hoped the Town Council would strengthen the hands of the Gas Committee, and would realize that this was not done from any vindictive spirit, but simply from a desire to do justly and fairly to every person whom they employed. The Council then divided, when 45 voted for the motion and 14 for the amendment.

I must say that the scheme of the promoters of this deputation was, on the surface of it, very adroitly formed. A motion for inquiry is always a difficult one to resist, because, if refused, it is open to the discontents to say afterwards that there was something to conceal. I have no doubt but that, if inquiry had been granted, it would have been found that the grievances were imaginary. But a step would have been taken towards the recognition of the Union; and this is one of those instances in which a step once taken cannot be retraced. The scheme was, however, only calculated to be effective with the portion of the community who do their thinking superficially. If a body of workers have permission to appear before the Town Council, they do not need to care much what the action of a Committee of the Council may have been. And if their complaint be simply that the Committee did not hear them, and, instead of asking the Council to consider their case, they simply ask it to be sent back to the Committee, it may be taken for granted that they have very little to complain of. The deputation served its purpose; and I daresay the promoters of it are quite pleased with the result. They will have a try another time. It is fortunate that their tactics do not affect the working of the undertaking, the staffs of which, with the exception of a few, are quite contented with the existing conditions. To a workman who is disposed to be diligent, signing-on is no grievance. It is the opposite, because it ensures him in constant employment and better prospects.

The Council, at a later stage, remitted to the Gas Committee to consider the motion of which notice was given by Mr. O'Hare at the meeting in August, in which it is proposed that parliamentary powers be asked for the establishment of a superannuation fund in connection with the Gas Department, to be compulsory upon all officials except the General Manager and the Treasurer, and that the Corporation take over, and appropriate in connection therewith, any funds handed to the Corporation by the old Gas Companies for benevolent purposes.

The great mountain of discontent with the conducting of the Greenock Corporation gas undertaking has this week dwindled to the proverbial molehill. On Tuesday, at a meeting of the Police Board, it was reported that the total income of the Gas Trust for the past year amounted to £47 679, and the ordinary expenditure to £41,484—showing a gross profit of £6195. But there was an extraordinary expenditure of £8802; so that the net deficit on the year's working was £2606. The estimated revenue for the current year has been put at £51,680, the ordinary expenditure at £43,110, the extraordinary expenditure at £7900, and the estimated surplus at £670. The Sub-Committee appointed to inquire into the difference between the financial results and the estimates for the year reported that the price paid for cannel accounted to some extent for the deficiency shown in the balance-sheet. It was therefore recommended that there should be a system of check on the supply made by the coal

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 755.

Issue.	Share	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment	Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	**GAS COMPANIES.**			£ s. d.	£			p. c.	**GAS COMPANIES.**			£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p. c.	18½—19½	..	5 7 8	60,000	5	Feb. 23	7	Ottoman, Ltd. . . .	5—5½	..	6 7 3
100,000	10	,,	7½	Do. 7 p. c.	15½—14½	..	5 3 5	500,000	100	June 1	6	People's Gas 2nd Mtg. of Chicago Bonds	102—106	..	5 13 2
800,000	100	July 2	5	Australian 5 p. c. Deb. .	101—103	..	4 17 1								
270,000	5	May 16	6	Bombay, Ltd. . . .	6—6½	..	4 12 4	851,070	10	Apl. 27	7	River Plate Ord. . . .	10½—11	..	6 7 3
40,000	5	,,	6	Do. New, £4 paid .	4—4½	..	5 6 8	250,000	Stk.	June 28	4	Do. 4 p. c. Deb. .	99—101	..	3 19 8
880,000	Stk.	Aug. 15	12	Brentford Consolidated	245—255	..	4 14 1	250,000	10	Apl. 11	8	San Paulo, Ltd. . . .	1½—12½	..	6 8 0
270,000	,,	,,	9	Do. New . . .	177—182	..	4 18 11	135,000	Stk.	Sept. 14	10	Sheffield A.	231—239*	..	4 3 8
50,000	,,	,,	5	Do. 5 p. c. Pref. .	140—145	..	3 9 0	209,7.0	,,	,,	10	Do. B.	231—239*	..	4 3 8
159,375	,,	June 14	4	Do. 4 p. c. Deb. .	116—120	..	3 6 8	447,427	,,	,,	10	Do. C.	232—237*	..	4 4 5
220,000	Stk.	Sept. 14	10	Brighton & Hove Orig. .	220—230*	..	4 6 11	5,641,885	Stk.	Aug. 15	5½	South Metrop., 4 p. c. Ord.	127—129	..	4 2 7
926,320	,,	,,	7	Do. A. Ord. Stk. .	150—160*	..	4 7 6	1,520,000	,,	July 12	3	Do. 3 p. c. Deb. . .	94—97	..	3 1 10
1,003,500	Stk.	Aug. 29	5	Bristol, 5 p. c. max. .	117—118	..	4 4 9	380,940	Stk.	May 16	5	Southampton Ord. . .	110—115	−5	4 6 11
420,000	20	Mar. 29	10	British	40—42	..	4 15 3	70,825	,,	July 12	4	Do. 4 p. c. Deb.	117—122	..	3 5 7
50,000	10	Aug. 15	12	Bromley, Ord. 10 p. c. .	24—26	..	4 12 4	120,000	Stk.	Aug. 30	6	Tottenham A. 5 p.c. and B. 3½ p.c. Edmonton 4 p. c. Deb.	112—117	..	5 2 7
79,000	10	,,	9	Do. 7 p. c. . . .	19—21	..	4 5 8	250,520	,,	,,	4½		80—85	..	5 5 11
500,000	10	May 16	6	Buenos Ayres (New) Ltd.	8¾—9½	..	6 9 9	61,550	,,	June 14	4		111—115	..	3 9 7
220,000	Stk.	June 14	4	Do. 4 p. c. Deb. .	98—100	..	4 0 0	182,380	10	Jan. 12	5	Tuscan, Ltd.	7—8	..	6 5 0
150,000	20	July 12	8½	Cagliari, Ltd. . . .	23—25	..	6 12 0	149,900	10	July 2	5	Do. 5 p. c. Deb. Red.	98—102	..	4 18 0
100,000	10	June 14	8	Cape Town & Dis., Ltd.	13½—14½	..	5 10 4								
50,000	50	May 2	6	Do. 6 p. c. 1st Mort.	54—56	..	5 7 2								
550,000	Stk.	Apl. 11	13½	Commercial Old Stock .	270—280	..	4 16 5								
236,425	,,	,,	10½	Do. New do. .	205—215	..	4 17 8								
288,237	,,	June 14	4½	Do. 4½ p. c. Deb. .	133—138	..	3 5 3								
800,000	Stk.	May 31	9	Continental Union, Ltd.	165—170	+5	5 5 11					**WATER COMPANIES.**			
200,000	,,	,,	7	Do. 7 p. c. Pref. .	170—175	..	4 0 0	780,404	Stk.	June 28	11	Chelsea, Ord.	300—305	+2	3 12 2
51,600	Stk.	—	14	Croydon A 10 p. c. . .	—	..	—	150,000	,,	,,	5	Do. 5 p. c. Pref. .	155—160	..	3 2 6
178,400	,,	—	11	Do. B 7 p. c. . .	—	..	—	160,000	,,	,,	4½	Do. 4½ p. c. Pref. 75	143—148	..	3 0 10
555,000	Stk.	Aug. 15	5½	Crystal Palace Ord. 5 p. c.	115—120	+3	4 7 6	175,785	,,	Mar. 29	4½	Do. 4½ p. c. Deb. .	145—150	..	3 0 0
60,000	,,	,,	5	Do. 5 p. c. Pref. .	130—135	..	3 14 1	1,720,560	Stk.	Apl. 11	7	East London, Ord. . .	193—198	+1	3 10 8
486,090	10	July 27	11	European, Ltd. . . .	19—20	..	5 10 0	654,740	,,	June 14	4½	Do. 4½ p. c. Deb. .	147—152	..	2 19 3
354,060	10	,,	11	Do. £7 10s. paid .	14—15	..	5 10 0	890,000	,,	,,	3	Do. 3 p. c. Deb. .	96—98	..	3 1 3
14,993,075	Stk.	Aug. 15	4 1/5	Gas-light and Coke 4 p. c. Ord. . . 3½ p. c. max. . 4 p. c. Con. Pref. 3 p. c. Con. Deb.	97—99	..	4 8 10	700,000	50	June 14	7½	Grand Junction 10 p. c. max. . 4 p. c. Deb. .	107—110	..	3 8 2
2,600,000	,,	,,	3½		92—94	..	3 14 6	810,000	Stk.	Mar. 29	4		130—135	..	2 19 3
3,799,735	,,	,,	4		114—117	..	3 8 5	708,000	Stk.	Aug. 30	14	Kent	295—305	..	4 11 10
3,993,975	,,	June 14	3		93—95	..	3 8 2	160,000	,,	,,	7	Do. New, 7 p. c. max. .	200—210	..	3 6 8
70,000	10	May 31	8	Hongkong & China, Ltd.	13½—14½	..	5 10 4	1,043,800	100	June 28	10½	Lambeth, 10 p. c. max. .	285—290	+1	3 13 5
3,800,000	Stk.	May 16	10	Imperial Continental .	204—209	+1	4 15 8	406,200	100	,,	8	Do. 7½ p. c. max. .	205—210	..	3 16 2
473,600	Stk.	Aug. 15	3½	Do. 3½ p. c. Deb. Red.	99—101	..	3 9 4	850,000	Stk.	Mar. 29	4	Do. 4 p. c. Deb. .	128—132	..	3 0 7
75,000	5	June 14	6	Malta & Medn., Ltd. .	4½—5	..	6 0 0	500,000	100	Aug. 15	14	New River, New Shares	410—415	..	3 7 6
560,000	100	Apl. 2	5	Met. of 5 p. c. Deb.	107—110	..	4 10 11	1,000,000	Stk.	July 27	4	Do. 4 p. c. Deb. .	128—133	..	3 0 2
250,000	100	,,	4½	Melbourne 4½ p. c. Deb.	106—108	..	4 3 4	902,300	Stk.	June 14	7½	South-wark Ord. . . . 7½ p. c. max., and 5 p. c. Pref. Vauxhall 4 p. c. A Deb.	195—200	+2	3 15 0
541,920	20	May 31	3½	Monte Video, Ltd. . .	10½—11½	..	6 1 8	126,500	100	,,	7½		182—187	..	4 0 3
667,946	Stk.	Aug. 30	9½	Newc'tle & Gatesh'd Con.	210—215	..	4 6 1	489,200	Stk.	,,	5		155—160	..	3 2 6
299,855	Stk.	June 28	8½	Do. 8½ p. c. Deb. .	104—107	..	3 5 5	1,019,585	,,	Apl. 11	4		129—134	..	2 19 9
160,000	5	May 16	8	Oriental, Ltd. . . .	7¾—7¾	..	5 3 8	1,155,066	Stk.	June 14	10	West Middlesex . . .	274—279	+1	3 12 2
135,000	5	,,	8	Do. New, £4 10s. pd.	6—6½	..	5 10 10	200,000	,,	,,	4½	Do. 4½ p. c. Deb. .	140—145	..	3 2 1
15,000	5	,,	8	Do. do. 1879, £1 pd.	1½—1½	..	4 11 5	200,000	,,	Sept. 14	8	Do. 8 p. c. Deb. .	97—99*	..	3 0 7
					*Ex. div.								*Ex div.		

contractors. They stated that 4515 tons of coal contracted for were not delivered. The price of coal averaged 15s. 8½d. per ton for supplies other than on the original contracts; and this caused excess expenditure of £795 10s. 6d. The Sub-Committee, after making a number of recommendations, pointed out that the deficiency was accounted for by the increase in price of coals and the payment from revenue of several sums which might have been held over till the following year. They recommended that meantime the price of gas, as from the last collection in May, be 3s. 4d. per 1000 cubic feet. The Special Committee approved of the report, and expressed regret that the Police Board were not informed of the non-fulfilment of certain coal contracts. A report was also submitted by the Gas Manager on the financial results of last year's working, He pointed out that the quantity of gas to be made during the year was estimated at 290,000,000 cubic feet; and the coal to be used was estimated at 30,000 tons, giving an average make of gas of 9666 cubic feet per ton. The average price of this coal was estimated at 12s. per ton. The actual quantity of gas made, however, was 304,400,000 cubic feet; being an increase of 14,400,000 cubic feet over the estimated quantity. The coal used was 32,500 tons, or an increase of 2500 tons over the estimated quantity; and it gave only an average make of 9366 cubic feet of gas per ton. This average make per ton was due to deficiency in the quality of the coal during the hurry of winter months and difficulties of the coal supply. References were also made in this report to the difficulties of getting coal delivered in time; and this delay, it was stated, added to the shortness of retort power, forced him to use a greater quantity of the better class of coal than had been estimated for, so as to provide an efficient supply of gas. The report and recommendations were adopted. There was, however, some discussion upon the point of whether the increase in the price of gas should be made retrospective, and also upon a proposal that the collector should be required to give details of open accounts in the annual balance-sheet, in order that the sum in his hands should be disclosed. The Police Board were very evenly divided upon the latter subject; the motion being only adopted by 10 votes to 8. It was clear that it was founded upon some feeling; and it probably explains the high state of excitement which has prevailed in the town over the gas management. There is evidently a sharp cleavage among the members of the Board upon gas matters, which does not augur well for the appointment they are about to make. The short leet they have selected, out of 40 applicants, is given below. Some names which I expected to see are not there; but probably these men retired. Let no one be surprised if, in the present state of mind among the members, the applicant whom they may consider best for the post should not be appointed.

The following have been selected by the Gas Committee of the Greenock Corporation as a short leet of candidates for the post of Gas Manager: Mr. J. M'Nair, of Wishaw; Mr. Willam Ewing, of Hamilton; Mr. W. Mackie, of Port Glasgow; Mr. J. Ballantyne, of Rothesay; Mr. W. Currie, of Alexandria; Mr. T. Lighbody, of Renfrew; and Mr. J. M'Cubbin, of Chorley, near Manchester.

Before his departure from Forfar, Mr. Forbes Waddell has had the satisfaction of receiving a vote of the Corporation which must go far to remove many unpleasant recollections. At a meeting on Wednesday, he was voted an honorarium of £30, as a recognition of the improvements he has effected upon the gas-works during his residence in the town. There was no direct opposition to the proposal; but his old antagonist Mr. Christie gave vent to some of his characteristic fulminations, and objected to the standing orders being suspended to allow the motion to be made, on the ground that they should have more time to consider such a proposal. He was defeated on this point, and did not move against the vote. Another member moved that the honorarium be £15; and Mr. Christie seconded this. They were the only two who supported the proposal; and the original motion was agreed to. On the evening of the same day, Mr. and Mrs. Waddell were presented by the employees in the gas-works with a cane and umbrella respectively, both articles heavily mounted, as tokens of esteem.

The accounts of the Arbroath Gas Corporation, dealing with the period from May 31, 1899, to July 15, 1900—being the period fixed for the closing of the accounts annually by their new Act—have been issued. In his report, Mr. R. S. Carlow, the Engineer and Manager, states that in this period the quantity of coal used was 7363 tons, as against 6623 tons in 1898-99; being an increase of 740 tons, or 11·17 per cent. The period is six weeks more than the year, and does not, therefore, show a fair comparison with the previous twelve months. Taking the figures for the year to May 31 last, the result is as follows: The quantity of coal used was 6940 tons, as against 6623 tons in 1898-99; being an increase of 317 tons, or 4·79 per cent., during the year ending May 31 last. In the longer period, the output of gas was 68,431,600 cubic feet, as against 62,887,900 feet in the previous year, which is an increase of 5,543,700 cubic feet, or 8·81 per cent. The result for the year to May 31 last was as follows: 64,651,500 cubic feet, as against 62,887,900 feet the previous year, an increase of 1,763,600 cubic feet, or 2·8 per cent. During the longer period, the make has been 9263 cubic feet per ton, which is a decrease of 202 feet, or 2·12 per cent.; and the gas sold has been 8140 cubic feet per ton, which is a decrease of 312 cubic feet, or 3·69 per cent. The result for the year to May 31 last was as follows: The make was 9314 cubic feet per ton, a decrease of 181 cubic feet, or 1·9 per cent.; and the gas sold was 8636 cubic feet per ton, an increase of 184 cubic feet, or 2·17 per cent. For the longer period unaccounted-for gas was 12·4 per cent., an increase of 2·87 per cent. The unaccounted-for gas for the year 1898-99 was 9·53 per cent. of the quantity made; last year it was 7·28 per cent., which was a decrease of 2·25 per cent. The illuminating power of the gas supplied to consumers has averaged 25·2 candles. The number of consumers for the year ending May, 1899, was 5759; for the period to July 15 last, the number was 5945—an increase of 186. In presenting the accounts at a meeting of the Corporation on Thursday night, Mr. Dundas said that the revenue for the period amounted to £13,842, of which £12,271 was derived from gas, £1268 from chemicals, and £214 from coke. The expenditure amounted to £14,093; and there was thus a deficiency of £251. The deficiency, however, was more apparent than real, and was caused mainly by the addition of the six weeks to the year; as during this time their expenditure on wages and coal had been going on, while the gas consumed had not yet been entered in the books. The matter would right itself during the current

CARBURETTED WATER-GAS APPARATUS

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	Cubic Feet Daily.
BLACKBURN	1,250,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000
SALTLEY WORKS, BIRMINGHAM	2,000,000
COLCHESTER	300,000
BIRKENHEAD	2,250,000
SWINDON (New Swindon Gas Co.)	120,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000
WINDSOR ST., BIRMINGHAM (Second Cont.)	2,000,000
HALIFAX	1,000,000
TORONTO	250,000
OTTAWA	250,000
LINDSAY (Remodelled)	125,000
MONTREAL	500,000
TORONTO (Second Contract; Remodelled)	2,000,000
BELLEVILLE	250,000
OTTAWA (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000
ST. CATHERINES (Remodelled)	250,000
KINGSTON, PA..	125,000
PETERBOROUGH, ONT.	250,000
WILKESBARRE, PA..	750,000
ST. CATHERINES (Second Contract)	250,000
BUFFALO, N.Y..	2,000,000

	Cubic Feet Daily.
WINNIPEG, MAN.	500,000
COLCHESTER (Second Contract)	300,000
YORK	750,000
ROCHESTER	500,000
KINGSTON, ONT.,	300,000
CRYSTAL PALACE DISTRICT	2,000,000
DULUTH, MINN.	300,000
CATERHAM	150,000
LEICESTER	2,000,000
ENSCHEDE (HOLLAND)	150,000
BUENOS AYRES (RIVER PLATE CO.)	700,000
BURNLEY	1,500,000
KINGSTON-ON-THAMES	1,750,000
ACCRINGTON	500,000
TONBRIDGE	300,000
STRETFORD	500,000
OLDBURY	300,000
TODMORDEN	500,000
SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
YORK (Second Contract)	750,000
ROCHESTER (Second Contract)	500,000
NEWPORT (MON.)	250,000
TOKIO, JAPAN	1,000,000

Complete Gas-Works at NELSON, BRITISH COLUMBIA.

year. Under the new Act, a sum of £245 had been paid to the Harbour Trustees. The accounts were approved of. The Finance Committee submitted estimates for the current year, which show an expected surplus of £128; and they recommended that the price of gas be raised by 2½d., making it 4s. 4½d. per 1000 cubic feet. Provost Grant said they were fortunate that the increase in the price of gas was not larger. It was much less than in many other places; and had the Manager not had a very large stock of coal on hand, which was purchased at a low rate, the increase would have required to have been much more than it was. The recommendation of the Committee was adopted.

The Burgh Commissioners of Milngavie have come to the conclusion that, in the meantime, they should not recommend the ratepayers to adopt the Burghs Gas Supply Acts, with a view to taking over the undertaking of the Gas Company; but they are of opinion that, if the Company were to quote a price, the matter might be further considered.

The Largs Burgh Commissioners have failed to adopt the Burghs Gas Supply Acts. At a meeting this week, the adoption was moved; and the voting for and against was equal. It requires a majority of three-fourths to carry the adoption of the Acts; and so the proposal fell through.

The Directors of the Cowdenbeath Gas Company met this week with an expert Engineer, and received his opinion as to the feasibility and the cost of re-converting the concern into a coal-gas works. They unanimously adopted his recommendations, and gave the Secretary instructions to raise the necessary capital. It is expected that coal gas will be supplied in about two months from now.

The Inverkeithing Gas Company have advanced the price of gas from 6s. 8d. to 6s. 10½d. per 1000 cubic feet. The increased cost of coal would have warranted a greater increase; but the Directors have resolved to reduce the dividend to be paid next year.

Bervie is a small and decaying town, in which there is an annual output of gas of about 330,000 cubic feet. The Gas Company have a debit balance of £111, of which £51 was incurred last year. The Town Council have been communicated with on the question of taking over the undertaking; and they have replied asking the terms proposed by the Company. A meeting of the shareholders is to be held to consider the matter. The price of gas was increased from 8s. 4d. to 9s. 2d. per 1000 cubic feet.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 22.

Sulphate of Ammonia.—Although there has been more business doing, it has not been sufficient to arrest the decline in values; the closing quotations being £10 10s. per ton f.o.b. Hull and Leith, and £10 15s. per ton f.o.b. Liverpool. There have been sales at second hand at £10 8s. 9d. per ton f.o.b. Leith. The particular weakness of the Scotch market has no doubt been occasioned by the blocking of shipments from Glasgow, owing to the plague; and the higher prices obtainable at Liverpool have been caused by the placing of additional orders at that point. In the forward position, there continues to be large inquiry; but buyers' ideas are too low to admit of much business—makers being only anxious to sell for prompt or early delivery. For delivery up to the end of the year, they require a stiff premium on prompt prices, while for January-March, and January-June they decline to offer. There are, however, speculative sellers for October-December, or October-March, at £10 15s. per ton, f.o.b. Leith. London (Beckton terms) is offered at £10 15s. per ton; but this price is not so far obtainable.

Nitrate of Soda is quiet at 8s. 1½d. to 8s. 4½d. per cwt. according to quality on spot.

LONDON, *Sept.* 22.

Tar Products.—There is a somewhat better inquiry for benzol, and the make is well taken up. Prices for both 50's and 90's are better. Unexpectedly large quantities of benzol are now going into gas enrichment, apparently removing the surplus that has kept the market value down so long. In solvent naphtha there is more business doing; but for other kinds of naphtha, there is no improvement in price. Creosote is still dull. Pitch is moderately steady. Carbolic acid is firm. Naphthalene is also in better odour; but in the aggregate there is very little of an encouraging character.

Average quotations for the week are: Tar, 15s. to 23s. Pitch, east coast, 37s.; west coast, 32s. 6d. Benzol, 90's, 10½d.; 50's, 11½d. Toluol, 1s. 2d. Solvent naphtha, 1s. 2½d. Crude naphtha, 3½d. Heavy naphtha, 1s. Creosote, 1½d. to 2d. Heavy oils, 2¾d. Carbolic acid, 60's, 2s. 11d. Naphthalene, 70s.; salts, 45s. Anthracene nominal, "A," 3½d. to 4d.; "B," 2½d.

Sulphate of Ammonia.—This market is very slack with only a little new business being reported. It looks very much as if sulphate has again got into the hands of the middlemen, who are operating the market much as they like. There are, however, no stocks in the country. The consumption is steadily increasing all over the world; and it is expected that the present low prices are only temporary. To-day's value at all ports will average about £10 11s. 3d. per ton, less 3½ per cent.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The talk of a further advance in prices with the close of the present month, which was very rife in one or two quarters, has been definitely disposed of by the decision come to at a meeting of the Lancashire Coal Sales Association, held in Manchester on Tuesday last, and by the attitude taken up by the principal colliery firms in the Manchester district. At the Coal Sales Association meeting, several representatives from the West Lancashire district strongly urged that the owners would be justified in advancing round coal prices 1s. 8d. per ton on Oct. 1, when the first of the series of three 5 per cent. advances in wages would come into operation. In face, however, of the decision on the part of the leading Manchester coalowners not to make any move at all with the close of the present month, the proposal from West Lancashire for a further advance met with very little support; and

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ultimately it was decided that the whole question of prices should be adjourned for five weeks. The better qualities of round coal continue in fairly active request for house-fire purposes; and in most cases collieries are readily disposing of all they are raising, with the result that no stocks are as yet accumulating, which undoubtedly is strengthening the position for the winter. But whether later on prices will be advanced, remains a very open question. At the pit mouth, list prices are firm at 16s. 6d. to 17s. per ton for best Wigan Arley, 15s. to 15s. 6d. for Pemberton four-feet and seconds Arley, and 14s. to 14s. 6d. for common house coal. Common round coals are also in tolerably good inland demand for steam and forge purposes, with pit prices strong at 12s. 6d. to 13s. per ton. It is, however, probable that, but for the continued pressure of shipping orders, coalowners might just now have some surplus supplies on their hands. Anything, however, they have to offer beyond their inland demand, they can sell at much better prices for shipment; good qualities of steam coal fetching from 17s. to 18s. per ton delivered at the Mersey ports. The weak point in the market is the position as regards engine fuel, the demand for which has fallen off considerably, owing to the unsatisfactory outlook in the cotton trade; and there was an anticipation in the market that, at the meeting of the Coal Sales Association, some reduction in prices might be announced. The Lancashire coalowners, however, do not consider that the situation at all necessitates any reduction of prices, as, although many of them are putting down into stock, it is believed this will be required during the ensuing winter; and for the present they remain indifferent to the underselling which is going on, with slack coming in from other districts. The average prices quoted, however, show an easing down from the top figures which were asked a short time back; and 10s. 6d. represents a full average figure for good rough Lancashire slack at the pit, while the finer screened slacks can be bought at considerably below this figure, and in many cases have been sent away for shipment at low prices. For furnace cokes, a moderate demand is reported, with prices ranging from 20s. to 21s. per ton at the ovens. Foundry cokes are perhaps in rather better request; and for these prices are being well maintained, according to quality, at from 28s. to 31s. per ton at the ovens.

Northern Coal Trade.—There is rather a different aspect of the two branches of the northern coal trade at present. The steam coal trade is quieter, and with prices falling; but the Durham coal trade is active, with the output fully taken up. Best Northumbrian steam coals have fallen in price to about 18s. per ton f.o.b., since the beginning of the closing of the Baltic demand. Steam smalls are also lower, and are quoted at from 11s. to 11s. 6d. per ton f.o.b. It is possible that lower values may be known for this class of coal. In the gas coal trade, there is now a better demand; and the quantities that are taken on contracts have been appreciably raised. With rapid voyages of steamers, a large tonnage of coals is now being delivered to the great gas companies. For occasional cargoes, the price quoted is about 18s. per ton f.o.b.; but little is being sold in this way at present. Some new contracts are in treaty; and it is expected that about 16s. per ton f.o.b. will be the price. In coke, export qualities are quieter at about 30s. to 32s. 6d. per ton f.o.b. Blast-furnace coke has been quoted at 27s. 6d. to 28s., free on Teesside. As to gas coke, the best test is found in the fact that the Newcastle School Board contracts have been placed at 25s. per ton, or about 7s. per ton above those of the past year.

Scotch Coal Trade.—The demand is still maintained, and prices are unchanged. These are quoted as: Main 15s. to 15s. 3d. per ton f.o.b. Glasgow, ell 16s. 6d. to 17s. 6d., and splint 16s. to 17s. The shipments for the week amounted to 265,578 tons—an increase of 4076 tons over the previous week, and of 53,219 tons over the corresponding week of last year. For the year to date, the total shipments have been 7,742,704 tons—an increase of 1,455,324 tons.

The Local Government Board and the Manufacture of Water Gas.—The Darlington Corporation must be numbered among the authorities to whom the Local Government Board have refused to sanction loans for the erection of water-gas plant. In view of this, the Gas and Electric Lighting Committee have considered it desirable to put aside some of the profits of the past half year for the purpose of meeting the outlay. It is stated that the six months' profits on the undertakings controlled by the Committee are very satisfactory.

Extension of Incandescent Gas Lighting at Oldham.—Mr. Arthur Andrew, the Superintendent of the Oldham Corporation Gas Department, has reported to the Committee that the system of incandescent gas lighting adopted in Clegg Street and Wellington Street has been an improvement on the old method; and he therefore suggests that about 100 or 200 additional lamps of this description should be placed in the main thoroughfares of the town. The existing lamps, he adds, could be altered to suit the light, at a cost of about 20s. each. The suggestion has been adopted.

Water-Works Improvements at Wellington.—A Local Government inquiry has been held at Wellington, by Mr. H. P. Boulnois, relative to an application by the Council for sanction to borrow £4000 for the purposes of water supply, including the construction of works in the parish of Hadley. The facts bearing upon the matter were stated by the Clerk (Mr. J. W. Littlewood). He referred to the powers of the Council as water suppliers, and mentioned that the cost of purchasing the rights of the old Water Company amounted to £12,000. The balance of the loan obtained to acquire these rights now amounted to £7513. He further recounted the steps that the Council had had to take to prevent other authorities securing rights of supply in Hadley. Mr. M. Morley, Surveyor to the Council, said the present supply of water from the Wrekin and Steeraway reservoirs reached 160,000 gallons a day; and a considerable quantity ran to waste besides. The population already supplied numbered a little more than 7000; thus giving an average of about 23 gallons per head per day. The population the Council proposed to be able to provide for in future at Hadley was about 4000. It appeared clear from the evidence that Hadley required an improved supply; and, although there was a little opposition, the Inspector opined that the Wellington authority were the people who would ultimately be responsible for its provision.

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Windsor Gaslight Company.—Addressing the shareholders at the half-yearly meeting of this Company, the Chairman (Mr. J. L. Hollis) stated that sufficient had been earned to pay the maximum dividends on all classes of shares, notwithstanding that the cost of coal had risen from £3544 to £4077. The outlay on purifying materials and wages had increased; but the distribution expenses had decreased. The total expenditure for the half year amounted to £7736, against £7293. The amount carried to profit and loss was £2133, as compared with £2055. The consumption of gas by private consumers was 41,962,600 cubic feet, against 41,500,000 cubic feet. Then 346,500 cubic feet were supplied to lamps outside the Corporation district, against 1,225,000 feet consumed for public lighting last year. The receipts from residuals showed a marked improvement; coke bringing in £1844, as against £1458. The total revenue was £9869, as compared with £9348. Regarding the increase in the price of gas, he said the Directors had no alternative but to raise it. The last contract for coal was at 15s. 9d. per ton; and they now had to pay 22s. 9d. per ton—an increase of 7s. The consumption in the year was 10,000 tons; so that coal would cost them £3500 more. Putting sales of gas at 85,000,000 cubic feet for the year, the increase of 6d. per 1000 cubic feet would give them £2125, leaving £1375 to be realized from other sources. It was hoped the better price for residuals would make up the greater part of this; but anyhow it would be seen that they were not putting the whole of the great increase in the cost of coals on the consumers. The report was adopted.

Shrewsbury Corporation Water Supply.—For some years past the time has been opportune for an amendment in the water supply of Shrewsbury; but thinking that the present time is peculiarly so, Mr. Roff King, at the meeting of the Shrewsbury Town Council yesterday week, proposed the following resolution: "That the question of augmenting the drinking supply of the borough by obtaining additional water from an upland source, from springs in the conduit area, or other sources, is worthy of the careful consideration of this Council, and that the Water Committee be requested to investigate the same and report thereon." Mr. King carried his arguments to the point at which he held that it was necessary an upland source should be decided upon; and he suggested the Habberley Valley or the Castle Pulverbatch scheme, estimated to cost £59,000. He did not propose that this scheme could be carried out at the present time for that estimate. Instead of a reservoir to hold 42,000,000 gallons, as proposed by Mr. Baldwin Latham, a small one to hold (say) 200,000 gallons, and much nearer home, would answer their present purpose, and serve as a subsiding reservoir later on; while as to mains, he suggested that since they had to obtain their wayleave and open the ground, it would be as well to lay down a 12-inch pipe that would form part of the whole scheme. The Chairman of the Finance Committee had told them that they could spend £40,000 without any addition to the rates. Surely such works as he proposed could be carried out for a much less sum. There were also other means of augmenting their supply of water which he thought deserved careful consideration; and he named them. There was very little discussion on the resolution, which was rejected. Past experience evidently has prejudiced the Council against tinkering with the supply.

Leeds Corporation Water-Works.—It was reported to the Leeds Corporation Water Committee last Friday that a new 300-horse power Cornish engine has been set to work at the Arthington pumping-station, and is delivering water into the Eccup reservoir. In a few days twin engines of 300-horse power, which have been undergoing repairs, will be engaged on the same work. An 18-inch main for supplying Shadwell with water from the Moortown reservoir will shortly be completed; and steps are being taken to lay an additional 18-inch main from the pumping-station at Headingley to Bramley.

Proposed New Water Supply for Harrogate.—At the meeting of the Harrogate Town Council yesterday week, a report by the Water-Works Committee was presented on the question of securing an additional water supply for Harrogate. The Committee stated that they had visited the available districts of water supply in the watersheds of the Rivers Nidd and Ure, and the best available scheme was undoubtedly the one recommended by their Water Engineer (Mr. E. W. Dixon), at the junction of the Agill and the Arnagill, to utilize the water from these streams, and construct a reservoir near their junction, on the estate of Lord Masham. The Corporation instructed their Engineer to prepare the necessary plans to be presented to Parliament next session for the carrying out of such a scheme.

Water-Works for Upper Greetland.—On Friday, the 7th inst., the works which have been constructed for furnishing Upper Greetland with an adequate supply of pure water were formally opened by Sir George J. Armytage, Bart., the Chairman of the Halifax Rural District Council, They have been constructed on the verge of Norland Moor, near the springs, and just at the boundary between Norland and Upper Greetland. The plans were prepared by Mr. F. Gordon, the Engineer to the Council, who is responsible for the carrying out of the scheme. The reservoir, which is 50 feet long, 40 feet wide, and 5 feet deep, has a capacity of 66,000 gallons, and will contain 21 days' supply for 45 houses in Upper Greetland, allowing 15 gallons per head per day. The whole scheme has been carried out at an outlay of about £1500.

Horwich Water Supply.—At a recent special meeting of the Water Committee of the Horwich Urban District Council, the Chairman (Mr. J. Dickinson) moved that the seal of the Council should be affixed to certain agreements for leases for water rights. In doing so, he sketched the history of the undertaking, and stated that in 1897 the average daily consumption of water was 175,298 gallons; in 1898 it was 152,362 gallons (the reduction being due to the stoppage of leakage); in 1899 it was 151,131 gallons; for the first six months of the current year it was 165,832 gallons; while last month it was 179,000 gallons. In the draft scheme they had adopted, the additional yield of water would, on an average, be 325,000 gallons a day; making with their present supply 475,000 gallons. If anyone questioned the necessity for this additional supply, he replied that it was useless to ask the Local Government Board to sanction a scheme which only provided for present needs. They must make provision for years to come. The reservoir would be constructed at such an altitude as to serve the whole of the district by gravitation. The extra service of water had been obtained at a cost not exceeding about 1d. per 1000 gallons.

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The Projected Water Scheme for Cumberland.—On Tuesday, at the meeting of the Wigton Rural District Council an important decision was arrived at with regard to the Overwater and Head of Ellen water scheme. The meeting was asked to approve of a resolution in favour of the promotion of a Bill in the next session of Parliament for the constitution and incorporation of a Joint Water Board for the Aspatria, Holme Cultram, and Wigton districts, with a view to carrying out a joint scheme. The resolution was supported by fourteen members; but as a majority vote of all the councillors was not forthcoming, it fell to the ground. This decision practically excludes the Wigton rural district from taking further action, as a body, in the promotion of the scheme. The Holme Cultram and Aspatria Councils have, however, adopted the resolution; and meetings of the ratepayers will be held to confirm their action.

Conviction for an Extensive Theft of Water.—At the Sessions of the Central Criminal Court, just concluded, Joseph Holland, a builder, was charged with stealing 900,000 gallons of water, the property of the East London Water-Works Company. The hearing of the case was commenced at the previous sessions; but, owing to illness in the family of one of the Jurymen, it was adjourned. From the evidence adduced, it appeared that the defendant was engaged in building some houses on an estate in the neighbourhood of West Ham; and it was alleged that he had surreptitiously used water belonging to the Company for the purpose of the building operations. For the defence it was contended that there was absolutely no foundation for the charge. The defendant had an income of £2000 a year; and his Counsel ridiculed the suggestion that he would have taken water without paying for it. The defendant gave evidence denying the charge. He said that he got water for his building operations from two wells and a ballast-hole which he dug on the estate. After a two days' trial, the Jury found the prisoner "Guilty," and he was sentenced to nine months' imprisonment in the second division.

Association for Amending the Law Regarding the Rating of Reservoirs.—The Thames Ditton District Council recently sought the advice of the Local Government Board as to their power to contribute to the funds of the Association formed for the purpose of amending the law relating to the rating of reservoirs. The Board, in their reply, state that they are not aware of any statutory power enabling the Council to make such a contribution. It will be a matter for the District Auditor to decide; and the Board may then be appealed to against his decision. Upon this the Council, with commendable caution, have resolved to hear the result of Sunbury's action in subscribing; and meanwhile for the edification of the Sunbury Council, they have forwarded to them a copy of the Local Government Board's communication. On the matter being mentioned at a meeting of the Sunbury Council yesterday week, it was stated that a pamphlet was being prepared dealing with the subject of the rating of reservoirs, which was of a non-party nature, but contained questions which might be asked of parliamentary candidates. No less than 647 circulars had been posted to different rating authorities in the United Kingdom; and replies, he was pleased to say, were coming in pretty freely at present.

The Thames Ditton District Council and the Lambeth Water Company's Bill.—In reply to inquiries by the Thames Ditton District Council as to whether their costs in opposing the Lambeth Water Bill last session could be provided for by a loan, the Local Government Board have written that, on the information furnished, it did not appear that they had the power to sanction a loan for such a purpose. The Council intend submitting to the Board a statement of circumstances and reasons why a loan should be granted.

A Retrograde District Council.—Not long since the District Council of Oakengates decided to adopt oil for public lighting, because the Gas Company would not allow them to fix their own price! Why they should be permitted to settle the price they should pay for gas any more than for any other commodity, is not at all clear, and so need not be discussed. But by this time, there is little doubt that, if the councillors possess sufficient common-sense, they have realized that many of their constituents regard their action as a retrograde one. The "reflections" on the subject of one correspondent of a local paper has led him to blossom out into verse, in which he foresees the time when the retrogression of these councillors will end in them "painting their corporeal frames, instead of wearing clothes." But on the oil lighting, he says—

> The consequences of this scheme
> There can be little doubt of;
> For Oakengates most folk will deem
> A fine place to live *out of;*
> And those who "pay the piper" there
> With natural amaze
> Behold their town regarded as
> A light of other days.

Whaley Bridge Water Supply.—Last Wednesday, Mr. H. Percy Boulnois, M.Inst.C.E., held a Local Government Board inquiry into an application by the Whaley Bridge Urban Council for powers to borrow £7000 for providing a water supply for the district. There was some opposition to the scheme on the grounds of the water supply of the works being imperilled. The Inspector stated that, of course, all existing water rights would have to be respected, or compensation allowed. The Stockport Corporation (through the Town Clerk) stated that an arrangement had been made satisfactory to the Urban Council; and Stockport's opposition had been withdrawn. It was agreed that the former body should furnish the Corporation with a daily supply of water, not exceeding 10,000 gallons, for the Furness Vale portion of the Disley township, which adjoins that of the Whaley Bridge Council's district, for 15 years, or so long as they were able—the price to be based upon 1d. per 1000 gallons profit on the actual cost of such water to the Council. Subsequently details of the scheme were given by Mr. Stirling, the Engineer, showing that, in addition to the Council acquiring the existing plant and works of Colonel Cotton Jodrell at Slow Heads for £900, it was proposed to secure an underground water supply from a bore-hole at Dig Lee Clough, Furness Vale, and to make a reservoir of sufficient area to furnish 400 houses and a population of 1450 with 20 gallons of water per head—with provision to increase the supply when required. The assessable value of the district was stated to be £5448; and the acreage 1322.

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Rothwell Gas Company.—At the half-yearly meeting of this Company, it was reported that the gross profit was £2746, being more by £263 than at the same period last year; but the expenses were greater by £479, caused by heavier charges for coal, &c. The net profit was less by £215 than for the corresponding half last year. The advance of 5s. per ton in the price of coal under the new contracts would, it was stated, mean an increased cost of production of 8d. per 1000 cubic feet of gas sold; but it was estimated that an increase of 3d. in the price of gas and the additional value of coke would to a large extent cover this higher expenditure. Resolutions were passed adopting the report and accounts and agreeing to the payment of the maximum dividend of 10 per cent. The shareholders also authorized the Directors to borrow £1000 additional loan capital.

The Bury Joint Water Board.—The Bury Joint Water Board has been duly formed, and the first meeting of the new authority held. Alderman Brierley, who has been Chairman of the Water-Works Committee of the Bury Corporation for some years, is Chairman of the Board, and Mr. J. Cunliffe, a member of the Radcliffe District Council, is Deputy-Chairman. Mr. J. Haslam, the Town Clerk of Bury, is Clerk; Mr. R. W. Buxton, Treasurer; and Mr. R. Rigby, Acting Manager. The newly-constituted Board comprise representatives of the Bury Corporation, and the Little Lever, Haslingden, Rawtenstall, Radcliffe, Whitefield, Tottington, and Bury Rural District Councils. The Board have taken over the water undertaking from the Bury Corporation, refunding the amounts expended from the borough fund and the special water-rate by Bury since 1872, to make good the losses incurred in working the undertaking—in all amounting to £150,000.

A Mendacious Gas-Meter.—During the past week, the daily Press, both London and Provincial, have been trying to amuse their readers over the strange case of a gas-meter which has been slothful in duty at the public baths and wash-houses of the Rotherhithe Vestry for the last eighteen years. The matter first obtained publicity at the meeting of the Vestry last Tuesday evening, when a letter was read from the South Metropolitan Gas Company, stating that it had just been discovered that the gas-meter at the public baths and wash-houses had been recording only one tenth of the actual quantity consumed during the past eighteen years. The dial had registered hundreds for thousands, and thousands for tens of thousands. The Company, therefore, sent in a bill for these arrears, which amounted to £2927 14s. 9d. The Directors, it was added, would be willing to accept payment of this amount by instalments. It was stated that the Baths Committee had observed the small quantity of gas registered, and had even gone to the trouble of having the meter tested some years ago. It was then returned as quite correct. The letter having been read, the members of the Vestry grew quite facetious over the matter. But amid the humorous remarks, it was observed by the Chairman that, even if the Company were entitled to anything, they could not claim for more than six years; the prior period being covered by the Statute of Limitations. But there would certainly be a desperate fight to get even the six years. The matter was referred to the Baths Committee.

Margate and its Water Supply.—At last week's meeting of the Margate Town Council, a long discussion took place as to the water supply of the borough. It originated in a proposal that the opinion of two engineers and a geologist should be taken on a report prepared by the Borough Engineer, Mr. A. Latham. He estimated that the requirements of the town at the height of the season amounted to 1,225,000 gallons per day, and suggested that the present supply should not be depended upon for more than 650,000 gallons per day, to prevent over-pumping at the two stations. At the present rate of increase, he estimated that in 20 years' time the daily consumption would amount to 2,000,000 gallons, and any new scheme undertaken should be capable of yielding this quantity, so as to make the town independent of the present sources of supply, if at any time it was found necessary to abandon them. After pointing out the impossibility of securing a new area in the Isle of Thanet from which such a supply could be procured in a dry summer, Mr. Latham placed before the Council two alternative schemes—one to obtain an independent supply from the North Stream, Sandwich, at an estimated cost of £100,760, and the other for obtaining a supply from Wingham, at an estimated cost of £90,829. Both these estimates were based on a supply of a million gallons per day. In the course of the debate, an alternative scheme—using sea water for flushing and street watering purposes—was suggested; it being contended that in this way the present supply of water for potable purposes is far ahead of what would be required for many years to come.

Alderman Hayday (West Ham) has been appointed official organizer to the Gas Workers and General Labourers' Union.

Messrs. R. Laidlaw and Son, of Edinburgh, have secured the contract for the whole of the gas-meters required by the Glasgow Corporation during the next twelve months.

Orders have just been received by Messrs. Kirkham, Hulett, and Chandler, Limited, for their "Standard" Washer-Scrubbers from the Clay Cross Company, the Herne Bay Gas Company, and the Clacton Urban District Council.

Last week, the Great Northern Railway began running a train between King's Cross and Hatfield fitted with a new gas apparatus for lighting the carriages. The taps are connected with the vacuum brake, so that when the train pulls up at a station the lights in the carriages are automatically lowered.

The accounts of the East London Water Company for the half year ended Midsummer show a net balance of £64,098 available for dividend, out of which the Directors recommend a dividend on the ordinary stock at the rate of 7 per cent. per annum, less income-tax; leaving a balance of £3879 to be carried forward.

Owing to the alarming report of an analyst on the water supply, the Ilford District Council have passed a resolution urging that Ilford should unite with the adjoining Councils of Romford and Barking to promote a Bill in Parliament authorizing them to buy up the South Essex Water Company and to construct new works.

R. & A. MAIN, Ltd.

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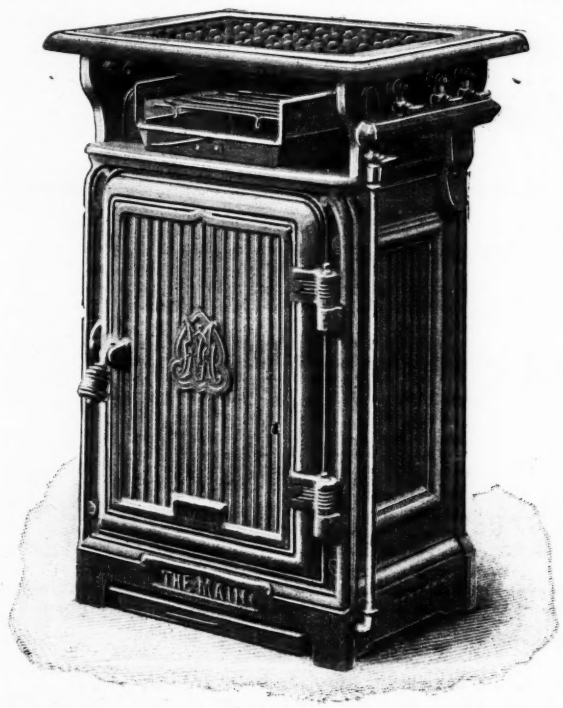
THE NEW "MAIN" PREPAYMENT METER COOKER.



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Enamelled Door Plate and Loose White Enamelled Crown, extra.

Nos.	1211	1212	1213	1214
List Prices	45s. 0d.	47s. 6d.	52s. 6d.	56s. 6d.

Full Particulars and Special Quotations on Application.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale than all other Oxides combined. Purity and uniformity of quality guaranteed.

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ANDREW STEPHENSON, AGENT. All communications *re* Oxide to the Company as above.

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"VOLCANIC" FIRE CEMENT.

Resists 4500° Fahr. Best for use in GAS-WORKS.

ANDREW STEPHENSON,
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Old Broad Street,
"Volcanism, London." London, E.C.

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Offices: Commercial Buildings, LEEDS. Correspondence invited.

ENRICH your Gas with cheap Benzol, Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER AND CO., MIDDLESBROUGH.

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Before placing Orders, please write for Estimate.
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SADLER & CO., Ltd., Middlesbrough, Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

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VICTORIA PAINT WORKS,
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HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
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PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."
[For Illustrated Advertisement, see Sept. 4, p. 608.]

TUITION IN GAS MANUFACTURE.

YOUNG Gentlemen coached in modern Gas Making, and for City and Guilds Examinations, by Correspondence. Strictly confidential.
For Fees, Results, &c., apply, by letter, to No. 3567, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Situation (Temporary or Permanent) by first-class GAS-FITTER; used also to Main and Service work. Highest References.
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GAS Manager's Son (age 18) desires a Situation on a Gas-Works, 3½ Years' Experience at Indicing, Collecting, Store Keeping, and generally assisting Manager. Very willing and persevering.
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OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
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JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application.
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DRAWINGS, Tracings, and Specifications PREPARED and NEATLY EXECUTED, for Apparatus, Structures, or Extensions to Gas-Works, either designed or drawn to Engineer's Sketches by Draughtsmen of experience.
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CORRESPONDENCE Classes. Students prepared for the CITY AND GUILDS EXAMINATIONS, Ordinary or Honours Grade, by an experienced Teacher. Successes: Four Seasons Four Medals; last Season's Class, Honours Grade, 100 per cent. passed, 60 per cent. First-Class, First Honours Medal and Prize.
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STOKERS wanted, used to Shovel Charging. Constant Employment for good, steady Men. Wages 31s. per week.
Apply to BENJAMIN BARK, Gas-Works, GODALMING.

WANTED, an experienced and good SULPHATE MAKER. Permanent employment to a steady Man.
State Age and Wages required to the MANAGER, Gas-Works, SOWERBY BRIDGE.

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Apply, stating Age and Wages required, to ARTHUR GRAHAM, Gas and Water Manager, MANSFIELD.

DEVONPORT GAS AND COKE COMPANY.

THE Directors of the above Company require, as soon as possible, a good, practical ENGINEER and MANAGER.
Applicants must have a thorough knowledge of the Manufacture, Purification, and Distribution of Gas also of Stoking Machinery and Regenerative Firing, be able to prepare Plans and construct New Works, and the making of Sulphate of Ammonia, and the erection of Plant for so doing.
Make of Gas per annum about 210 millions.
Salary to commence £300 per annum, with Residence, Rates, Coal, and Gas free.
Applicants to state Age, if Married, and the time when they could take up the duties; and Applications, addressed to the Chairman, accompanied by *copies* of three Testimonials, must be sent not later than Oct. 1 next.

FREDK. TRETHEWY,
Secretary.

Gas Offices, Devonport
Sept. 18, 1900.

Foolscap 4to, pp. 535, *with* 239 *Illustrations and Steel-Plate Engraving* (*as Frontispiece*) *of* WILLIAM MURDOCH, *Inventor of Gas Lighting. Morocco Gilt*, 21*s.*; *Roan Gilt*, 18*s.*

THE SIXTH (AND CENTENARY) EDITION OF THE

HANDBOOK

FOR

GAS ENGINEERS and MANAGERS.

By THOMAS NEWBIGGING, M.Inst.C.E.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

CLERK wanted for a Gas Company's Office to keep Gas-Rentals, make out Gas Accounts, &c.

Apply, stating Wages expected, Experience, and References, to No. 3569, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a steady, trustworthy Man to take Sole charge of small Gas-Works, making about 1¾ million feet. House, Coal, and Gas found.

Applications, stating Age and Wages required, to be sent in on or before Monday, Oct. 1, to MYLES GILBERT, Secretary to the Gaslight Company, NEEDHAM MARKET.

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WANTED, for a temporary Engagement, a good DRAUGHTSMAN, accustomed to preparing Detail Drawings of Gas-Works Plant.

Apply, stating Age, Qualifications, References, and Salary required, to No. 3571, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

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WANTED, by the Cowdenbeath Gas Company, Limited, a WORKING MANAGER, able to lay Main and Service Pipes, take Meter Indices, make the Gas, &c.

Apply, at once, stating Wages expected and Qualifications, to GEO. TERRIS, Burgh Chambers, Cowdenbeath, FIFE.

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(GAS DEPARTMENT.)

WANTED, a competent Main and SERVICE LAYER. Permanent Situation to a suitable Man.

Apply, stating Wages required, to the undersigned.

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WANTED, at a Gas-Works within 40 miles North of London (make 240 millions), a YARD and RETORT-HOUSE FOREMAN, to take alternate Twelve-Hour Day and Night Shifts. Must thoroughly understand construction and working of Regenerative Settings. Must also be well acquainted with all Gas Plant and supervision of Workmen. No House provided.

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SUPERINTENDENT OF MAINS.

WANTED by the Directors of this Company, an experienced and competent Man to superintend their Mains and Services Department. He must thoroughly understand the working of Governors, and be able to advise as to the correct sizes of Pipes required to ensure an adequate supply of Gas in all parts of the Company's district.

There are 460 miles of Mains in use at the present time.

Applications, marked "Superintendent of Mains," stating Age, Married or Single, previous Engagements, and Salary required, to be made by letter only, addressed to Sir Fredk. T. Mappin, Bart., M.P., Chairman of the Company, Gas Offices, Sheffield, not later than Friday, Sept. 28, 1900.

Testimonials not to be sent till asked for.

HANBURY THOMAS,
General Manager and Secretary.

Commercial Street, Sheffield,
Sept. 4, 1900.

GAS.

WANTED, a Set of Two (second-hand) PURIFIERS, 6 feet square, with 5 or 6 inch Valves and Connections complete.

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ADVERTISER is desirous of purchasing a complete Set of the ABOVE WORK, and will be prepared to pay a fair price for a Perfect and Clean copy.

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GASHOLDER for Sale, 25 feet diameter, 12 feet deep. Almost equal to new. Will be sold cheap.

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"CUTLER'S" Condenser, ¾ million day, equal to new; weight 12 tons; accept £100 on rail, Berkshire, if sold promptly.

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FOR SALE—Thirty Ordinary Shares of £10 each, fully paid, in Glover & Main, Limited. Dividends paid, during last three years, average 9½ per cent. per annum,

Offers, stating Price, to No. 3562, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

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MESSRS. Alex. Wright & Co., Ltd., have several second-hand EVANS & LETHEBY PHOTOMETERS, complete with Instruments in thorough working order and good condition, which they can offer at greatly reduced Prices.

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HIGH-PRICED COAL.

SMALL Gas-Works Authorities should immediately adopt an EXHAUSTER, and thus make probably at least 750 cubic feet of gas more from each ton of Coal carbonized. Several small sets *in stock*, both New and Second-hand.

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Full Particulars on application to A. DUDLEY CLARKE, Estate Office, Abberley, near STOURPORT.

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One Set of Three 6-ft. PURIFIERS.
One ,, Two 8-ft. ,,
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Four 5-inch ANNULAR CONDENSERS.
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"Cutler" ¾ million WATER CONDENSER.
Wrought-Iron TOWER SCRUBBERS, 3 ft. by 14 ft., 3 ft. 6 in. by 27 ft., and 7 ft. by 32 ft.
Cast-Iron TOWER SCRUBBERS, 3 ft. 6 in., 5 ft., and 6 ft. diameter.
EXHAUSTERS, 2000 to 60,000 Cubic Feet per hour.
"Holmes" & "Clapham" WASHER-SCRUBBERS.
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4-in., 6-in., 8-in., and 10-in. STATION METERS.
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RETORT IRONWORK, MODERN HYDRAULICS.

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EXCELLENT SET OF PURIFIERS FOR SALE.

THE Yeadon and Guiseley Gas Company have FOR SALE a set of Four PURIFIERS, 14 feet square, complete with Centre-Valve, Connections, and Travelling Lift. Also a separate CATCH PURIFIER of same size, with Slide-Valves and Travelling Lift.

The whole are now in use in excellent condition, but must be removed in about a month.

Offers will be received, and further information given, by the Manager, Mr. E. Lister.

Gas-Works, Yeadon,
Aug. 28, 1900.

EDINBURGH AND LEITH CORPORATIONS' GAS COMMISSIONERS.

GRANTON WORKS.

THE Commissioners are prepared to receive TENDERS for the construction of CARBONIZING PLANT upon the INCLINED RETORT PRINCIPLE, to the Design and Specification prepared by their Engineer.

Specification and Schedule of Quantities may be obtained upon a payment of Ten Guineas to Mr. W. R. Herring, Chief Engineer and Manager, New Street, Edinburgh; and detailed Drawings may be inspected at his Office by appointment any time on and after the 15th inst. The Ten Guineas will be returned on receipt of *bonâ-fide* Tenders.

Tenders will only be considered on the forms attached to the Specification and Schedule of Quantities, and must be delivered to the undersigned at or before Ten a.m., on the 8th of October, endorsed "Tender for Carbonizing Plant."

The Commissioners do not bind themselves to accept the lowest or any Offer.

JAMES M'G. JACK, Clerk.

25, Waterloo Place, Edinburgh,
Sept. 11, 1900.

BOROUGH OF KENDAL.
(GAS DEPARTMENT.)

GASHOLDER AND STEEL TANK.

THE Gas, Water, and Electricity Com- mittee of the above Corporation are prepared to receive TENDERS for the construction of a STEEL GASHOLDER TANK, 90 feet diameter by 25 feet deep; also of a TELESCOPIC GASHOLDER, Inlet and Outlet Pipes, and Appurtenances, to be erected at the Gas-Works, Kendal.

Copies of the Specification, Bill of Quantities, and Form of Tender may be obtained, and Plans seen, at the Office of Mr. T. N. Ritson, Assoc.M.Inst.C.E., Engineer and Manager, Gas-Works, Kendal, on payment of Three Guineas, which will be returned on receipt of a *bonâ-fide* Tender.

The Committee reserve the right to modify the abovementioned Specification and Plans, so as to enable Makers of Patent Cable and Spiral-Guided Gasholders and other persons wishing to avail themselves of Patent or other rights or facilities to tender in accordance with the Contractor's own Designs. Such alternative Designs, with complete Plans and Specifications, to be submitted to the Engineer, and approved by him before the Tenders are made.

Sealed Tenders, endorsed "Tank and Holder, Contract No. 2," to be delivered to the undersigned not later than Twelve o'clock noon on Wednesday, Oct. 31, 1900.

The Committee do not bind themselves to accept the lowest or any Tender.

(Signed) JOHN BOLTON,
Town Clerk.

Kent Street, Kendal,
September, 1900.

Now Ready. Price 12*s.* 6*d. net.*

GAS COMPANIES'

BOOK-KEEPING.

A PRACTICAL TREATISE ON THE KEEPING OF GAS COMPANIES' ACCOUNTS.

By JOHN HENRY BREARLEY and BENJAMIN TAYLOR, of Longwood.

The most complete Treatise on Gas Companies' Book-Keeping ever published.

This book will be found invaluable to those desirous of obtaining a thorough grasp of Gas Companies' Book-Keeping and Accountancy.

A complete set of Transactions are dealt with; the same being entered into the various Books, and posted into the Ledgers. A Model Balance-Sheet is prepared from the set of transactions and postings.

Forms and subsidiary books are illustrated and described. The linking together of the various books is shown at a glance by means of a Chart.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

TO TAR DISTILLERS AND OTHERS.

THE Directors of the Isle of Thanet Gas Company are prepared to receive TENDERS for the purchase of the surplus TAR produced at their Works from Oct. 1, 1900, to Sept. 30, 1901. The probable quantity will be about 250,000 Gallons, more or less.

Sealed Tenders, endorsed "Tar," to be sent in on or before Thursday, Oct. 4, 1900, addressed to the Chairman.

Further Particulars can be had on application to the Engineer, Mr. James Dougall.

The Directors do not bind themselves to accept the highest or any Tender.

By order,
T. C. FULLER,
Secretary.

Isle of Thanet Gas Company,
The Dane, Margate, Sept. 21, 1900.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company invite TENDERS for the purchase of 920 Tons of the surplus TAR, to be produced at their Works in Radcliffe during the Twelve Months commencing the 1st day of October next.

Particulars may be obtained from the undersigned, to whom endorsed Tenders must be delivered not later than Tuesday, the 2nd of October.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe,
Sept. 20, 1900.

LEA BRIDGE DISTRICT GAS COMPANY.

ISSUE OF £10,000 FIVE PER CENT. PREFERENCE STOCK, at a Minimum Price of £120 per £100, and £10,000 CONSOLIDATED ORDINARY STOCK, at a Minimum Price of £117 per £100.

THE Directors of the Lea Bridge District Gas Company hereby invite TENDERS for

£10,000 FIVE PER CENT. PREFERENCE STOCK,
AND
£10,000 CONSOLIDATED ORDINARY STOCK,

on which the last Dividend was at the rate of Six per Cent. per annum.

Full Particulars, Conditions, and Forms of Tender may be obtained on application to the SECRETARY, at the Company's Offices, 146, 147, and 148, Dashwood House, New Broad Street, LONDON, E.C.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
ILFORD GAS COMPANY.

£7500 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, the 9th of October, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
SOUTHEND WATER-WORKS COMPANY.

NEW ISSUE OF 500 £10 NEW ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, the 9th of October, at Two o'clock, in Lots.

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SOUTH-WEST SUBURBAN WATER COMPANY.

58 £10 FIVE PER CENT. PREFERENCE SHARES,
AND
117 £10 ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, the 9th of October, at Two o'clock.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

HARDMAN & HOLDEN, LD.

ESTABLISHED 1820.

SULPHURIC ACID.

GUARANTEED absolutely free from Arsenic and of excellent Purity. Specially prepared for Sulphate of Ammonia Manufacturers.

Works: BLACKBURN; Miles Platting and Clayton, MANCHESTER.

Head Office: Miles Platting, MANCHESTER.

Inquiries Solicited.

NITRATE of Thorium and Cerium. FABRIK CHEMISCHER PRAEPARATE VON STHAMER, NOACK, AND CO., HAMBURG.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.

Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.

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effects a great saving of time, labour, and expense.

For Particulars Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY, LIMITED,
NEWBATTLE COLLIERIES,
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UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

JAMES OAKES & CO.

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL CO., LD.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON.

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL CO., LD.
QUAYSIDE, NEWCASTLE-ON-TYNE.

HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,

CHESTERFIELD.

BOLDON GAS COALS.

Yield of Gas per Ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

As per Analysis by
Mr. JOHN PATTINSON, F.I.C., F.C.S.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON, NEWCASTLE."

THOMAS TURTON AND SONS, LIMITED,

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MANUFACTURERS OF

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STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.

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HOLMSIDE

GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton	11,205 Cubic Feet.
Illuminating Power	16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality)	13¾ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR

PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
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THE

"WELSBACH SHADOWLESS"

CYLINDRICAL LANTERN.

EFFICIENT. ELEGANT. ECONOMICAL.

SHADOWLESS AND GENERATIVE.
COMPLETELY WINDPROOF.

BREAKAGE OF GLASS
REDUCED TO A MINIMUM

Hinged top for convenience of Cleaning, &c., with door at bottom for lighting.

Perfect Diffusion.

Glass Cylinders Renewed at Small Cost.

WIDELY USED WITH BRILLIANT SUCCESS ON THE CONTINENT.

STRENGTH AND ELEGANCE COMBINED.

Galvanized Iron Top.
Glass Cylinder.
Cast-Iron Upper and Lower Rims.

A Perfect Lantern for thoroughly Economical and Efficient Incandescent Gas Lighting.

VERY MODERATE PRICE HIGHEST POSSIBLE LIGHTING EFFECT.

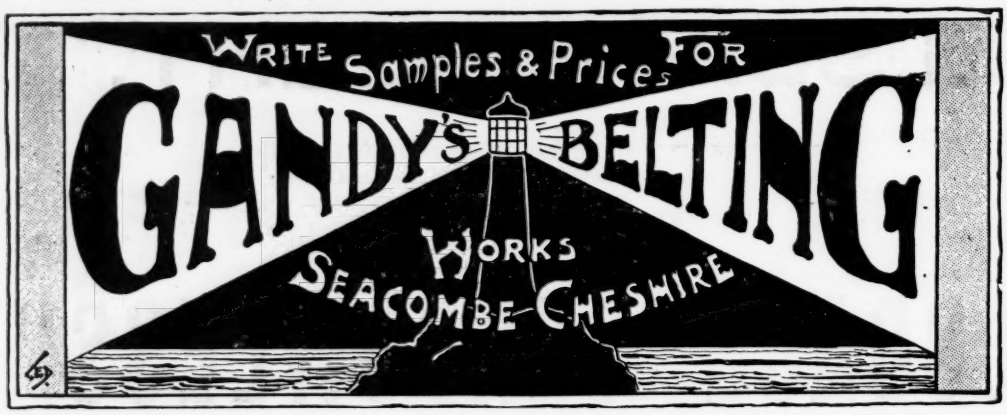
STRONGLY RECOMMENDED.

Special Prices for Lanterns for 1, 2, and 3-Light Clusters and upwards on application to

The Welsbach Incandescent Gas-Light Co.,

LIMITED,

Public Lighting Department, York Street, Westminster, London, S.W.



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Sole Agents for
"DODGE"
Standard
Wood Split
PULLEYS.

AS USED BY THE LEADING GAS AND WATER COMPANIES.

LONDONDERRY GAS COALS
FROM THE
LONDONDERRY COLLIERIES,
COUNTY OF DURHAM.
Available Output up to 5000 Tons per day.
Yield of Gas 11,000 cubic feet per Ton of Coal
as per Analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR,
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GAS-FITTINGS.
BURNERS
Welsbach Pattern
per 7/6 Doz.
WRITE FOR CATALOGUE.
WHOLESALE
FITTINGS COMPANY
80, Commercial Road,
London, E.
INCANDESCENT

WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.
Full Particulars on application to the Patentees:
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— LIMITED, —
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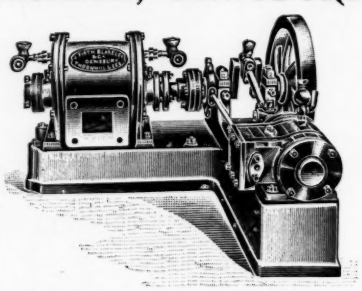
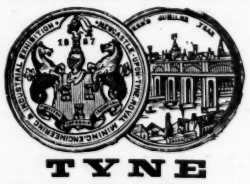
THE PATENT
"BEACON" GLOBE LAMP.

As fitted at London Bridge near Railway Approach, three Lamps giving the Illuminating Power of 600 Candles. See Surveyor's Report as published in the "JOURNAL" for Jan. 10, 1899.
H. GREENE & SONS, Ld.,
Late of Cannon Street,
19, Farringdon Road, E.C.
Telegrams: "LUMINOSITY, LONDON."

J. Firth Blakeley & Co.,
Gas Engineers,
Thornhill, DEWSBURY.

The High Prices of Coal should induce Small Gas Authorities to adopt an Exhauster, and thus effect a large saving in Coal.
Probably at least 750 cubic feet more Gas being made from each Ton of Coal Carbonized.
Several Sets of EXHAUSTING PLANT in Stock, both New and Second-hand.
Particulars sent on application.
Thorough Efficiency Guaranteed.
Exhausters, any capacity.
NEW GAS PLANT OF ALL KINDS. RETORT WORK, CONDENSERS, WASHERS, SCRUBBERS, PURIFIERS, METERS, GOVERNORS, GASHOLDERS, VALVES, &c., IN STOCK OR PROGRESS.
Photos. sent. Inspection invited.
Telegrams: "BLAKELEY, THORNHILL LEES."

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE
BOGHEAD
CANNEL.
Yield of Gas per ton . . . . 13,155 cub. ft.
Illuminating Power . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.
EAST PONTOP
GAS COAL.
Yield of Gas per ton . . . . 10,500 cub. ft.
Illuminating Power . . . . 17·8 candles.
Coke . . . . . 70 per cent.
SOUTH PELAW MAIN
GAS COAL.
Yield of Gas per ton . . . . 10,500 cub. ft.
Illuminating Power . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.
For Prices and complete Analysis, apply to
THOS. W. DANCE, SON, & HUNTER,
COAL OWNERS, NEWCASTLE-ON-TYNE;
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21, JOHN STREET, ADELPHI, LONDON, W.C.

WEST'S GAS IMPROVEMENT CO., LTD.,

ALBION IRON-WORKS, MILES PLATTING,

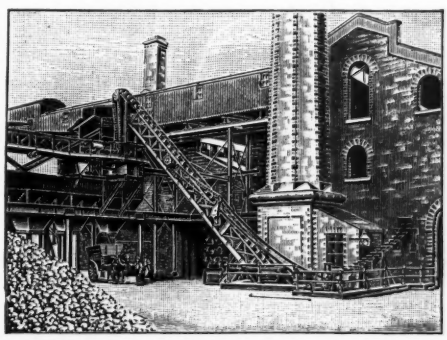
And 104, QUEEN VICTORIA STREET, LONDON, E.C. **MANCHESTER.**

SOLE MAKERS OF

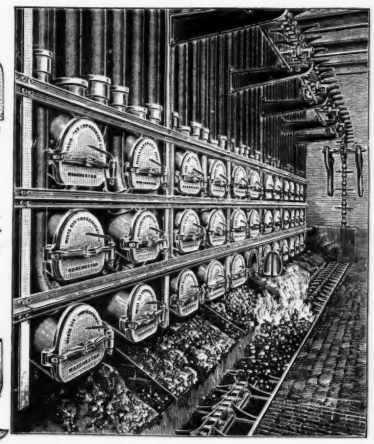
WEST'S STOKING MACHINERY FOR CHARGING AND DRAWING GAS-RETORTS.

ALSO

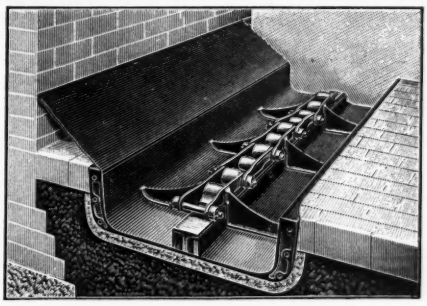
WEST'S PATENT SILENT COKE CONVEYOR



VIEW SHEWING END OF COKE CONVEYOR, ELEVATOR AND CONVEYOR FOR STORING COKE IN HOPPERS AND COKE YARD.



INTERIOR OF RETORT HOUSE SHEWING COKE CONVEYOR.



SECTION OF COKE CONVEYOR.

Silent in Action. Simple Wearing Parts. Does not make Breeze.

SPECIALLY ADAPTED FOR CONVEYING, ELEVATING, AND STACKING HOT COKE FROM GAS-RETORTS OR COKE-OVENS.

The Conveyor after leaving the Retort-House may be arranged to rise up an incline to any required height, and the Coke delivered from the Conveyor to the Coke-Store from any part of the Conveyor.

ALSO MAKERS OF

West's Coke Breaking, Sorting, Sizing, and Screening Machinery.
West's Patent Inclined and Horizontal Regenerator Settings.
Coal-Handling Machinery for Gas and Electric Light Works.

GAS AND GENERAL ENGINEERS.

IMPROVED PATENT
GAS GOVERNOR.

TESTIMONIAL FROM THE

PLYMOUTH & STONEHOUSE GASLIGHT & COKE CO.

"Our Engineer has reported to the Directors that the Patent Equilibrium Station Governor which you fixed here last year, replacing one of another make, is giving every satisfaction, and maintains an absolutely regular outlet pressure under most trying conditions. We consider the open-ended Cylindrical Valve perfect, and a great improvement on the usual complicated construction of Equilibrium Governors, which are generally only balanced in one position of their range."

The Inlet Pressure having absolutely no effect on the open-ended cylindrical Valve, the pressure is maintained constant at the outlet **UNDER ANY CHANGE OF PRESSURE OR DRAUGHT**, and dispenses with the usual complicated balancing arrangements.

Provided with a most **SIMPLE** and **CONVENIENT METHOD** of **WATER LOADING** and **WITHDRAWAL** without syphons or other complications, or with weights to adjust pressure as desired.

Manufacturers of Gasholders, Purifiers, and every description of Gas Plant of any capacity. Station Meters, Wet and Dry Consumers' Meters, Prepayment Meters, Gas Apparatus and Gas Fittings. Also Bridges, Roofs, Columns, Girders, and Structural Iron and Steel Work of all kinds. All Sizes of Livesey Washers kept in Stock.

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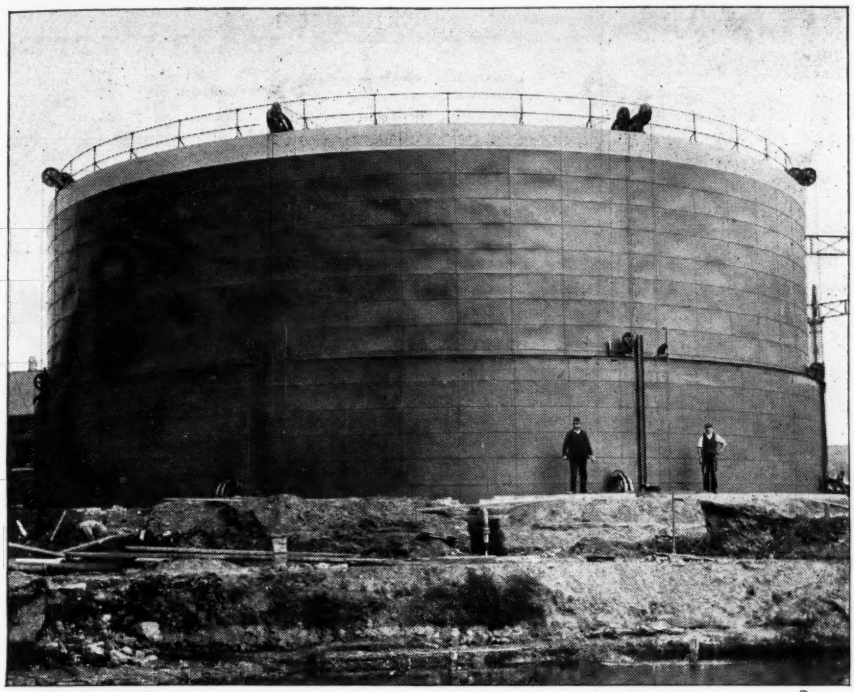
ENGINEERS, IRONFOUNDERS, & CONTRACTORS.

CHIEF OFFICES AND WORKS } **ST. THOMAS, EXETER.**

Telegrams: "WILLEY, EXETER."
Telephone: 132 and 263.

METER-WORKS—32a, Hertford Road, De Beauvoir Town, LONDON, N.; and James Street, EXETER.
OFFICES & DEPOTS—LONDON: 18, Adam Street, Adelphi; MANCHESTER: Victoria Buildings.
PLYMOUTH, DEVONPORT, SWANSEA, & NEWPORT.



Two-Lift Cable-Guided Gasholder, 80 ft. diameter by 20 ft. deep.
STAFFORD CORPORATION GAS-WORKS. (*From a Photo.*)

COPY OF TESTIMONIAL.

CORPORATION OF STAFFORD,
GAS & ELECTRICITY DEPARTMENT,
STAFFORD, *Feb.* 9, 1899.

Messrs.
ASHMORE, BENSON, PEASE, & CO., LTD.,
Stockton-on-Tees.

GENTLEMEN,

It affords me pleasure to state that our No. 2 Gasholder, from which you removed the outside Guide-Framing on account of it being defective due to the settlement of the foundations, and substituted your Steel-Wire Cable System for both Inner and Outer Lifts, has, since the alteration, **worked perfectly satisfactory.**

Its Stability and Rigidity under High Wind Pressures, when fully inflated, is such that **it preserves the level working of both Lifts, and gives a steady outlet pressure.**

I am, sincerely yours,
JNO. FERGUSON BELL,
Engineer.

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ASHMORE, BENSON, PEASE, & CO., LTD.,

STOCKTON-ON-TEES.

ESTABLISHED 1844. **ORIGINAL MAKERS.** ESTABLISHED 1844.

LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS;
The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.

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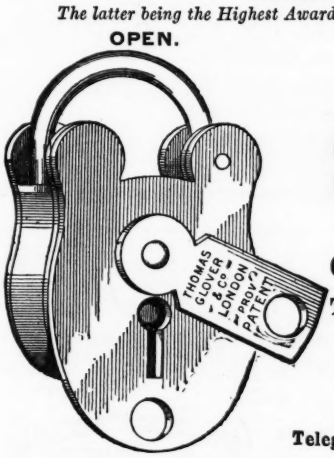

THOMAS GLOVER & CO.'S

PATENT

SECURE PADLOCK

PREVENTS TAMPERING WITH THE

CASH-BOXES OF PREPAYMENT METERS.

The Padlock is Sealed by means of a Lead Eyelet, which is impressed with Company's private mark. Eyelets easily fixed and removed by Company's Collector.

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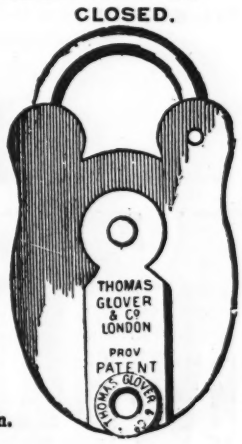

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

THOMAS GLOVER & CO., LTD.,

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214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

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BIRMINGHAM: 1, OOZELLS STREET. *Telegraphic Address:* "GOTHIC"

MANCHESTER: 87, BLACKFRIARS STREET. *Telegraphic Address:* "GOTHIC." Telephone No. 3008.

GLASGOW: 69-71, McALPINE STREET. *Telegraphic Address:* "GASMAIN" Telephone No. 6107.

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GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.

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THE THAMES BANK IRON CO.

UPPER GROUND STREET, LONDON, S.E.,

SUPPLY FROM STOCK

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SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

Sole Manufacturers of **LYON'S "PATENT" GAS-MAIN SYPHONS**

AGENTS FOR

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Patent Automatic Machinery

FOR

DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,

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[See Illustrated Advertisement, Sept. 4, p. 561.]

STEEL SCOOPS

FOR

RETORT CHARGING.

Scoops supplied with or without handles, and of any dimensions or shape required.

HENRY SYKES, Ltd., Engineers,

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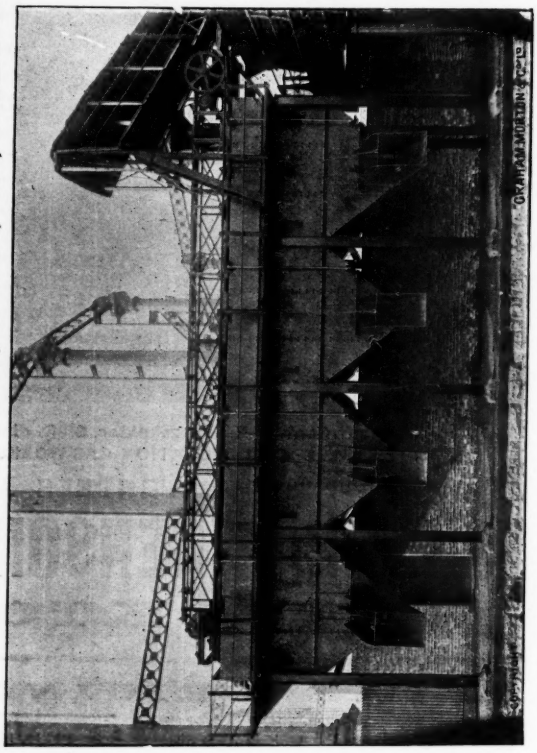
GRAHAM, MORTON, & CO., Ld., LEEDS.



THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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Manufacture & supply best quality of

Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)

Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.

FIRE BRICKS, LUMPS, & TILES; BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c., &c.

EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.

London Agents: Contractors for the erection of Retort-Benches complete.

BALE & HARDY, **Gas Engineers and Contractors,** BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C.

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MANUFACTURERS OF
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LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

Manufacturers of Glasshouse Pots and Crucibles of every kind.
Established 1836.

JOSEPH CLIFF & SONS,
INCORPORATED IN
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WORTLEY, LEEDS.

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MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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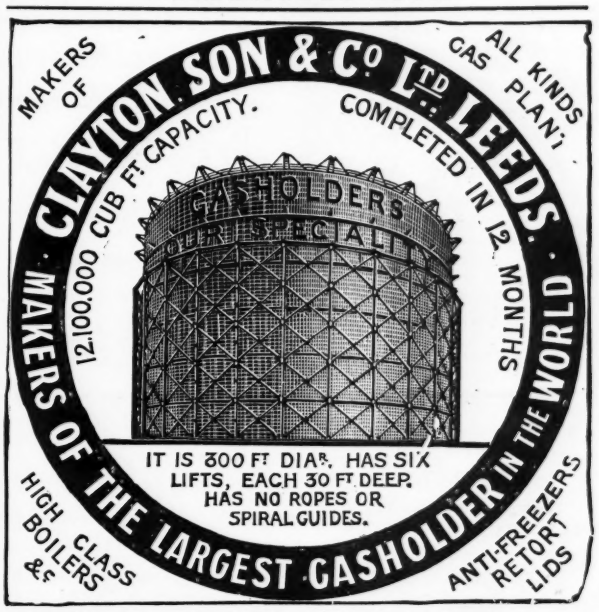
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ALL KINDS GAS PLANT
12,100,000 CUB FT CAPACITY.
COMPLETED IN 12 MONTHS
GASHOLDERS
SPECIALITY
IT IS 300 FT DIAR. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD
HIGH CLASS BOILERS &c
ANTI-FREEZERS RETORT LIDS

GIRDERS, ROOFS, & ALL KINDS OF STRUCTURAL IRONWORK.

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INTERESTING EXTRACT FROM AN ENGINEER'S LETTER.

RECEIVED JAN. 25, 1900.

"During the Summer this town was visited by a severe typhoon **LASTING THREE DAYS.** The peculiarity of our typhoon is the wind seems to come in **TREMENDOUS GUSTS** from varying directions. This, of course, tests the stability of any structure; and you will therefore be glad to hear that your **SPIRAL-GUIDED GASHOLDER** stood the trial admirably. Our Gasholders with Columns and Girders were oscillating over 4 inches; but although the spiral was inflated well up in the second lift, there was **NO VISIBLE MOVEMENT.** This is extremely gratifying to me after advising my Directors to adopt your type. Please let me know **IF YOU CAN INCREASE THE STORAGE OF MY OTHER GASHOLDERS ON THIS SYSTEM** by adding additional Lifts."

Any further Information required should be obtained from

R. & J. DEMPSTER, LTD.

(Who are Sole Proprietors of the Spiral Gasholder Patents),

GAS PLANT WORKS, OLDHAM ROAD,

MANCHESTER.

Telegraphic Address:
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Telephone Nos. 54 & 2296.

London Office:
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Old Broad Street, London, E.C.

HUTCHINSON BROS. & CO., LTD.

GAS ENGINEERS, &c.,

MANUFACTURERS OF IMPROVED

WET AND DRY GAS-METERS.

STATION-METERS. LAMP-METERS.

TEST GASHOLDERS & GENERAL GAS APPARATUS.

BRASS MAIN & LAMP TAPS. UNIONS, FERRULES, &c.

The "Falcon" Lamplighter's Torch. Service Cleaners.

SYPHON AND OTHER PUMPS.

Wood and Wrought-Iron Purifier-Grids. Scrubber Boards

WET AND DRY METERS REPAIRED.

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SERVICE CLEANER.

LAMP SERVICE CLEANER.

Telegraphic Address: "CLAPHAM BROS., KEIGHLEY."

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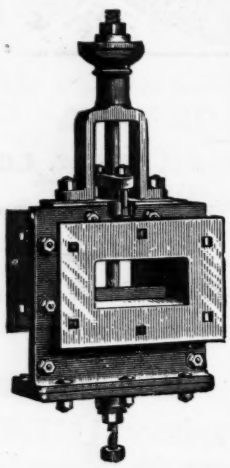

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